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INCENTIVE CONTRACTS AND COST GROWTH

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VOLUME I

ANALYSIS AND FINAL CONCLUSIONS

INTRODUCTION

Have incentive contracts worked? Or are they in the words of the late Carl Vinson "a give away and a ripoff?" Are they a panacea or a delusion? Incentive contracts are again a topic of general interest. The constant agitation by the Washington Post and the Chicago papers are but one example of the growing unrest and concern about the alleged horror stories of weapon systems that don't work, are late in delivery and cost too much. Are these concerns valid?

Cost growth has and is receiving increased attention of the Reagan Administration. Congressional actions have and are in the process of being implemented (Nunn Amendment, for example). The Senate has taken specific actions on the FY'83 budget to assure compliance to cost estimates. And the House has met to consider the establishment of cost assessment and quarterly status reports on all programs. Clearly patience is wearing thin.

As will be seen further along in this introduction, incentive contracts are not new. They were used for the last fifty years in varying degrees. In the late Forties, however, they were abandoned for the CPFF contract. Then McNamara changed that. He attacked the CPFF as the cause of the massive overruns. His solution was the profit motive. His vehicle was the renewal of the incentive contract. The CPFF went from thirty-eight percent to eight percent overnight. Incentives went from fourteen percent to a high of thirty-eight percent and remained high until the late Seventies. Have they worked?

This study has attempted to answer these complex issues. What is the nature of cost growth? What role does the contract play? Has the remedy applied for the last twenty years cured the patient or made him more ill? In pursuit of this inquiry four data sources have been used; these were a synopsis of the literature, questionnaires, pilot studies of contractors, and individual and group dialogs. The assumption was that based on over twenty-five years of experience in the field, the uses of these data bases would allow for an informed judgment concerning the basic aspects of the problem. The preliminary findings have been presented in two formal papers for critical review. The results of the questionnaire have been analyzed through computer assistance. The information from these and all the other sources was carefully weighed. The final product is this report.

There are never any simple, black or white solutions to multivariate problems. The case at hand is no exception. In the final analysis, judgments had to be made based on the clues revealed in the research. Every effort has been made to document carefully the process of how particular conclusions have been reached. There shall, of course, be differences of opinion concerning conclusions and recommendations. And this is how it should be. The intent is to provide a solid foundation of the literature and the theory from which particular issues can be debated and understood. If this has been accomplished, much can be done.

For the reader interested in the methodology and the details of the research project, please refer to the Appendix. Included there are the caveats, the particular methodology, and a copy of the questionnaire.

To assist the researcher each of the four data sources (questionnaires, in-house studies, literature base, workshops) are summarized by hypothesis. The advantage of this method is that those doing research on incentives can go to a particular hypothesis and find summarized all the findings. The disadvantage is the redundancy. Often specific studies and findings are applicable to more than one hypothesis. This sometimes results in apparent repetition. Each section stands on its own theoretical base.

At the end of each section is a summary statement on findings from each of the four data bases. This should be read for those not interested in the details.

BACKGROUND OF THE STUDY

This study has been conducted for the Air Force Business Research Management Center at Wright-Patterson Air Force Base, in Dayton, Ohio (AFBRMC). The project started on May 27, 1980. Almost three years have elapsed in its completion. It has consisted of three phases. Phase one was a literature search and documentation. Interviews were also conducted with key government and industry personnel. Phase two included the development and the distribution of a questionnaire to the NCMA membership. A series of small conferences with industry and government personnel, and a pilot study of several companies. The pilot study was designed to assess what companies actually do or do not do once an incentive contract was obtained. Phase three compiles and presents the final conclusions and recommendations.

At the outset, fourteen hypotheses were established based on the writer's twenty-five years experience. These were modified after phase one, based on the literature findings. All the existing literature was read in detail and synthesized into an organized reference document (phase one report). This document provided a readily available condensation of the literature base from which to construct and revise the planned questionnaire. After considering several sample options, it was mutually decided that the National Contract Management Association's twelve thousand members were the most appropriate universe. To encourage participation, an article on the project was written and published in the NCMA Magazine (See Appendix B). There were two mailings to the entire membership. In addition, questionnaires were distributed to selected recognized authorities. Further, questionnaires were made available at a variety of aerospace conferences. In all, some five hundred and twenty questionnaires were completed. The profile of the respondents is provided in Appendix C.

One of the major problems of the prior studies was the difficulty of reaching some semblance of reality through a statistical research format. They were and are open to all the classical arguments on validity. To circumvent this problem it was decided to utilize a broad data base. This included four sources. These were: (1) The search for and the condensation and synthesis of the literature, (2) The pilot study of company operations, (3) The NCMA questionnaires, (4) The small group workshops and interviews. The goal was to make some kind of expert judgment after carefully weighing the available information. The results are provided in this document. Each of the fourteen hypotheses are separately discussed. As each is addressed,

the conclusions from each of the separate data sources are presented.

At the end of each, final assessments are made. Each section is an entity and should be read as such.

THE HISTORY OF INCENTIVE CONTRACT USAGE

A type of incentive had been used in the First and Second World War periods. And the Navy and the Air Force had used variations in the Fifties. But the principle contract types utilized were the CPFF for development and variations of the fixed price for production. Then the problem became attenuated by the changing nature of the requirements. The items being procured became more sophisticated and more technologically complex. There was a shift away from the large production programs of the Second World War to smaller quantities. The development costs skyrocketed. The percentage of the end item price attributed to research and development ballooned. The Department of Defense moved to contract for development separately. Heretofore, much of the research and development was included in the unit costs of the end item. The problems had changed. New methods were needed to cope with the new environment. It is doubtful if the experience of the Forties and Fifties was any different than that of the Sixties. The dramatic shift in the cost of research and development relative to the end item cost dramatized the problem. The era of the modern weapon system buy was at hand. The stage was set for new methods and improved management techniques.

Secretary of Defense McNamara, upon taking office, dictated a host of initiatives that eventually changed the way the Department of Defense did business. Among these were revised procurement methods. Incentive contracts (particularly performance) were a focal point of his recommended

changes. Overnight Cost Fixed Fee (CFFF) contracts were changed to incentives. Goals were set to reduce the usage of CFFF contracts from 60% to 12%. The modern age of weapon system contracting had arrived.

The hopes for the incentive contract as conceived in the late Forties and early Sixties was that incentives would lead to improved performance, timely schedules and reasonable costs. Several factors led to the adoption of incentives. These were:

1. Evidence that there had been greatly inaccurate estimates of costs and schedules under the CFFF contract.
2. The belief that under the incentive contract the contractor would be motivated to improve on these problems.
3. The assumption that the government would improve on its own estimates of costs and schedules.
4. The belief that the budgetary system would operate more effectively.
5. The assumption that the pricing of change orders would be more realistic.
6. A disillusionment with legal remedies such as liquidated damages.
7. A long standing feeling that the government had injected itself too far into contractor surveillance and that the incentive contract would result in less.
8. A desire to motivate contractors to improve performance.
9. A general dissatisfaction with the CFFF contract.

CONTRACT USAGE SINCE 1951

The arrival was not without controversy. In the late Fifties, Karl Vinson, a pioneer for contractor surveillance legislation, led frequent and volatile attacks on the incentive contract usage. At the time of its heralded rebirth in 1961, the Army, for one, cautioned against its use. And DOD generally had imposed rather stiff requirements for its utilization.

What had been the history of incentives? As the contract chart shows, incentives were used widely in the Fifties. If CPIF and Fixed Price Incentive (FPI) are combined their average percentage use for 1951 was about nine percent. This rose rapidly in 1952 and 1953 to about 27%. Then a steady decline to 14% in 1961 ensued. Then McNamara's directive came out. It increased the percentage rapidly to about twenty-eight percent by 1963. It had then oscillated from 24% to 29% until 1969. And then rose rapidly to its thirty year high of almost thirty-nine percent by 1971. It sharply recessed back to thirty percent from 1971 to 1976. It rose again to thirty-three percent through 1979, and has dropped precipitously since, to the current level of 24%.

Much of the growth since the 1963 period has been in the FPI. The CPIF has maintained a rather steady eight to twelve percentage since 1967. With the 1967 secretarial push the CPIF went from its modest base of around four to its high of fourteen percent in 1964. In the next three years it came back down almost as fast as it had gone up. It came down to its current range of eight percent. It is also important to note the nose dive that the FPI made. It went from thirty-eight percent to eight percent in two years. Most significantly in 1952 through 1961, incentives dropped from twenty-six percent to fifteen percent. This occurred by shifting to

CPFF. In that same time period, CPFF went from twenty percent to thirty-eight percent. The FPI was traded for the CPFF.

Starting in 1962, the CPFF contract tumbled to twelve percent. That was the goal set by McNamara. In fact, the CPFF dropped from the thirty-eight to twelve in two years. At the same time, the fixed price contracts escalated exponentially. By 1966, the FP contracts skyrocketed to fifty-eight percent. The CPIF, the FPI and the fixed price replaced the CPFF. But the bulk was absorbed by the FP. The CPFF dropped thirty percent. Of this the CPIF accounted for nine percent, the FPI for six percent and the FP for twenty-six percent.

The following points are applicable:

1. Incentive contracts have been extensively used for the last thirty years.
2. Fewer incentive contracts are used today than in 1951.
3. The use of CPFF contract is about the same as it was in 1951.
4. The use of FPI is about the same as 1951.
5. The straight fixed price is in the same range as in 1951.
6. The major differences in 1981 compared to 1951 are:
 - A. The CPIF which was zero now is about eight percent and has had a recent range of about twelve percent.
 - B. The Fixed Price Escalation which was zero in 1951 is now at fifteen percent.
 - C. The Firm Fixed Price has all but disappeared. It was thirty-eight percent in 1952.
 - D. The Cost Plus Award Fee has crept into the picture. In 1951 none were reported, now it accounts for a modest three percent.

7. There were three distinct periods:

- A. From 1951 to 1961 the CPFF and the CPIF went up and everything else went down.
- B. From 1961 to 1971 the fixed price, the FPI and the CPIF went up and the CPFF came crashing down.
- C. From 1971 to 1981 incentive contract usage dropped significantly and has been replaced by the FPE, the FPI and the CPAF contracts. The incentive dropped fifteen points. Of this fifteen points the FPE picked up eleven points and the FP about four. The CPAF also accounted for a small amount.

For whatever reason the incentive contracts have fallen out of favor since 1970. Is it because they have not worked? Is it because of the problems in their negotiation and administration? It is the purpose of this study to find out.

THE BIG PICTURE

How serious is the problem of cost growth? It is staggering! In FY '81, DOD procurements totaled about \$105 billion. The General Accounting Office reported for FY 1981 that there were 1,040 major programs accounting for some \$776.7 billion for all federal agencies. Of this, the Department of Defense had 185 programs totaling about 286 billion dollars to completion. Of these there were fifty four programs that overran at least one hundred percent. More on this later.

Not all the industry segments shared equally. The \$105 billion was allocated approximately as shown below:

Aircraft	16.5%	Ships	7.5%
Electronics	11.5%	Tank Automotive	2.0%
Fuels	10.3%	Ammunition	2.0%
Missiles & Space	10.2%	Weapons	1.0%

Of particular interest is the method of procurement. In FY '81 about forty percent of the dollar amount and forty-eight percent of the transactions were competitively placed. Of those not competitively placed, forty percent were supplemental or follow-on contracts. About thirty percent of the dollar value of new procurements were sole source. Incentive contracts accounted for 20.9% of the dollars.

THE CURRENT STATUS OF COST GROWTH AND OVERRUNS

What is the current state of cost growth on the major systems? The Mar. 20, '81 report of the General Accounting Office is helpful in this regard. (MASAD-81-13) It reported costs for all federal acquisition programs and it focused on those that have had a cost growth of at least one hundred percent. (Note that the report stated that there had not been an attempt to verify the data submissions.)

The Department of Defense had 185 programs listed. The average cost growth from the baseline estimate was 52%. The average from the original estimate was 88%. Of this about half was accounted for by economic and quantity changes (3% economic and 26% quantity). The balance was revision of the estimated costs, engineering changes, schedule changes and support changes. The growth varied by service. The growth for the Air Force was substantially lower than either other service; Air Force - 12.5%, Army - 73%, and Navy - 81%. For the 185 programs with cost growth in excess of 100%

the statistics on the surface are grim. Of the fifty-four programs (14 AF, 17 Army and 23 Navy) the range of the cost growth was up to one thousand and seventy-five percent. The average was two hundred and twelve percent.

A frequency distribution by overruns are shown below:

<u>% OVERRUN RANGE</u>	<u>TOTAL</u>	<u>ARMY</u>	<u>AIR FORCE</u>	<u>NAVY</u>
0 to 50	12	5	3	4
50 to 100	8	3	3	2
100 to 150	9	2	2	5
150 to 200	4	1	1	2
200 to 300	6	1	2	3
300 to 400	4	0	2	2
400 to 500	4	0	0	1
500 to 600	0	0	0	0
600 to 700	0	0	0	0
800 to 900	0	0	0	0
900 to 1000	1	0	0	0

Of the fifty four, only five went down from the planning or development estimate.

From the chart one can see that there were ten programs with cost growth in excess of three hundred percent. Of these, four were in the three hundreds, four were in the four hundreds, one was in the five hundreds, finally one was about the one thousand percent level. It was and is not a pretty picture.

A peculiar coincidence is that all the services had about the same average cost growth for these programs reported. It was about two hundred

percent. The differences between the current and the planning or development estimate were allocated to quantity, engineering, support, schedule, economic, estimating and sundry. According to the figures presented, the variations due to estimates for the Air Force, Army and Navy respectively were, 4.6%, 21% and 10.8%. Could this be a reflection of contract type? For FY '81 the usage of CPIF and CPFF for the services were:

	CPIF	CPFF	CPAF	TOTAL
Air Force	9.1%	4.0%	1.7%	14.8%
Navy	10.1%	16.4%	7.8%	34.2%
Army	9.5%	11.5%	2.7%	23.7%

If there is a correlation it would be expected that the service with the most CPFF contracts would have the highest variation in change due to estimates. Both the Army and the Navy utilize cost contracts much more than the Air Force. Could this relationship between cost growth and contract type be a coincidence? The following explores this.

COST GROWTH BY CATEGORY

	QUANTITY	ENGINEERING	SUPPORT	SCHEDULE	ECONOMIC	ESTIMATING
Army	13%	2.9%	6%	12%	40%	21.0%
Air Force	18%	5.0%	9%	26%	36%	4.6%
Navy	33%	4.8%	6%	12%	30%	10.8%

A number of interesting observations can be made. The major influence was economic for all the services. The other big ones were quantity and schedule changes. The differences within the categories was sometimes dramatic. See for example, the differences attributed to quantity and scope changes. For the Army it was thirteen percent. Yet for the Air Force it was thirty-three percent. Schedule changes were double for the Air Force of that of the

sister services (26% to 12%). The estimating error of the Air Force was by far the lowest. The Army had twenty-one percent while the Air Force only had 4.6%

If a contractor does not "get in one place" will he indeed get it someplace else? Some observations:

1. The Navy used the highest percent of cost type contracts (34.2%).
2. The Navy had the highest quantity changes.
3. The Army had the greatest estimating deviation.
4. The estimating error for all three services was modest.
5. The major impact on the Army's programs was economic, quantity and schedule were next.
6. The major impact on the Air Force's programs was also economic. Schedule was twice that of the Navy.
7. The Navy's major growth was in quantity. The economic factor was a close second. Schedule was a weak third.

The services, even though they had a significantly different contract mix, all had about the same cost growth experience on the fifty-four programs considered.

Only a fool would suggest that there is not a cost growth problem. Fifty-four programs with more than one hundred percent cost growth is proof enough for all to see. As the following table clearly demonstrates, the problem is not unique to the Department of Defense. The Department of the Interior had an average of three hundred percent on twenty-four programs. The TVA has 276 percent, and the Washington Metro had 327 percent. The Appalachian Program was the highest at 835%. The table presents ratios for cost growth based on both the original estimate and the baseline estimate.

When the total number of programs are considered the picture is not as bleak. For the one hundred and eighty-five programs the average cost growth for the Air Force was thirty percent, for the Army one hundred and fifty percent and for the Navy one hundred and eighteen percent, based on the original estimates. If the baseline figures are used the figures are Air Force, 12.5%, the Army, 73%, and the Navy, 81%.

AVERAGE COST GROWTH FOR ALL PROGRAMS

AGENCY	# PROGRAMS	ORIGINAL	BASELINE
AIR FORCE	38	30	12.5
ARMY	50	150	73.0
NAVY	95	118	81.0
ENERGY	83	37	37.0
DEP. ARMY CORP. ENGINEERS	170	300	37.0
DEPT. OF INTERIOR WATER POWER	24	300	24.0
N.S.A	15	71	70.0
TVA	14	283	281.0
WASH. METRO	2	327	327.0
APPALACHIA	1	835	835.0
FED. HIGHWAY ADMIN.	5	365	365.0

To get an accurate picture one has to compare the original and baseline estimates. Some of the departments absorb the growth through the baseline estimate. In any event, as noted, the DOD does not have sole claim to the cost growth phenomenon. Based on the averages they are experiencing far less growth than their sister agencies or departments.

THE ORGANIZATION OF THE REPORT

There are three volumes to this report. Volume one is the analysis and final conclusions, part two is the pilot study and part three is the literature synopsis. Volume I is organized around the fourteen hypotheses of the study. Each is allotted a chapter. For each, the four sources of data are applied to the hypothesis separately. After the four are described and analyzed a final synthesis and conclusion is presented.. Each statement is carefully documented. The number of the reference in the parenthesis (e.g. (1)) relates to the page of Volume III that provides the literature synopsis. A summary of the findings are recommendations are included in the final section. Several appendixes are provided. These include the copy of the questionnaire respondents, and a summary by program of the cost growth experience of the Department of Defense for the fifty-four programs that have cost growth in excess of one hundred percent.

A FINAL NOTE TO THE READER

It will be tempting for the reader to look for evidence to support the conclusions that he has already drawn through his experience to date. To fully grasp the significance of the findings one must study the report in depth. Nothing in black or white. Judgments are unavoidable. Before using any of the findings, prudence would suggest that this report be read in its entirety.

HYPOTHESIS ONETHE TYPE OF CONTRACT IS NOT THE DETERMINING VARIABLE
AS TO THE OUTCOMES OF THE CONTRACTS.

Do contract personnel place too great an emphasis on contract type? Does the contract type make any difference? And if yes how much? There would be few of us to assert that the contractor's behavior is the same for a fixed price as for a CPFF. But how much difference is there? These kinds of questions are the focus of this hypothesis. It is assumed that the contract type is not the dominant variable in the behavioral process. Other factors such as current capacity mean more than the contract type. The research data is most revealing. For the most part the literature, the NCMA questionnaires, the pilot studies and interviews and workshops offered consistent conclusions. Each is separately addressed below.

THE LITERATURE

If the contract type is not the determining variable in contractor behavior, then what is? Since it is not reasonable to assert that the contract has no impact on behavior, then what is its effect? There is a wealth of research on contractor motivation but very little that focuses on the specific impact of a particular type of contract. Outputs are measured and compared but the particular behaviors that led to the outputs are hidden under the organizational umbrella. Much of the existing research cannot answer these questions. But some light is shed. A sample of the findings are condensed below.

An interesting perspective can be gleaned from the Congressional Hearings held by Karl Vinson. Vinson led the fight against incentives in

the late Fifties and early Sixties. A '59 hearing revealed that although profits were modest the return on net worth for aerospace contractors averaged an astonishing 71.3 percent (13).¹ In December of 1963, at an American Management Association meeting in New York city, Gordon Author, then head of pricing for the Air Force, cited several factors that had an impact on corporate behavior. He included follow-on production, current capacity, reputation and the need for technical excellence (19). The original NASA CPAF Guide also discussed extra-contractual factors that affected outcomes (26). These were similar to those listed in the DOD Incentive Contracting Guide of 1968 (27). Included as factors were growth, prestige, follow-on business, and capacity utilization.

Egan in his dissertation at Berkeley provided some insight on the issue. He noted that the real products of the aerospace companies are scientific skill and know-how. Follow-on business is dependent on technical accomplishment. The size of the firms and the intensity of the research effort are important behavioral considerations. These companies tend to achieve technical goals in spite of the contract form (39). Redden cited some similar concerns. Contractors can have a significant disutility for savings. They are motivated to incur costs to invest in facilities, to cover overhead from other projects, and to improve the products in order to be more competitive for follow-on business. They prefer a contract type that would permit cost flexibility. (52) Similarly Booz - Allen, in their comments on the effectiveness of incentives, concluded that extra-contractual factors play a major role in determining contractor behavior. Deavers and McCall of Rand also studied the importance of the contract in shaping behavior. They found that there was not a significant relationship

(1) This number is the page in Volume III where the article synopsis appears.

between contractor behavior and the shares of the incentive contracts in the 62-63 period. This contrasted with the results of the 59-62 period. What had changed? The contract type did not. There must have been other factors at play outside the contract. (58) Professor Hill of Syracuse University agreed. He spoke out against the single profit goal mentality. He stated: "Contractors have many goals. The motivational mix changes from project to project. Extra-contractual factors are important considerations in the determination of contractor behavior." In Hill's opinion these factors included at least public image, organizational prestige, commercial spinoff, and improved market position. Contractors attempted to insure their profits at the negotiation table. He also concluded that the size of the contract was far more important than type in the determination of contractor behavior. (61)

Troy Jones, then a Colonel in the Air Force, did a comprehensive analysis of the effectiveness of incentives. Many of his findings are reported in the various portions of this study. As to the impact of contract types on contract behavior he stated, "The level of technical uncertainty within a program continues to play a much stronger role in cost outcomes than the contract type under which the program is conducted." And again, as noted by previous researchers, extra-contractual factors played a larger part in determining contractor behavior than the contract type. (70) An LMI study into the foundations of incentive theory rang the same bell. Extra-contractual factors dominated and directed behavior. Contractor motivations included: company growth, share of market, public image, carry over benefits, follow-on business, technical competence, and executives. Since ROI, cash flow, and market share were utilized to

measure management achievement, these were important in determining corporate behavior. (74)

I. N. Fisher of Rand studied incentives at length and published several studies cited in the phase one report and bibliography. A common theme was that the same contractors are always underrunning and others always overrunning, therefore contractor behavior was not a function of the contract type. (76) Parker, in an Air Force Institute of Technology thesis, although not commenting directly, noted that contracts with high share rates tended to overrun. Also he found little correlation between shares and performance accomplishments. Reading between the lines his conclusions tend to reinforce those noted above. (82) Trimble took another tack but concluded similarly. He found that incentive contracts did not result in increased utilization of labor and capital by defense contractors. On the surface it appeared that the goals of the contract were ignored. (84) Why? Perhaps because there were other more attractive choices open to the contractor that matched his hidden motivational agenda.

M.W. Dixon (89), in a Naval Postgraduate study found no empirical evidence that the sharing ratio has any impact on contract performance outcomes. Cost savings advantages appeared to be fallacious. Hill and Shepard also of the Naval Postgraduate School were even more blatant in their remarks. Their conclusions were: 1. Incentives are not passed down within the organization, 2. Motivational programs do not vary much from company to company, and, 3. Administratively all contracts are alike in the eyes of the contractor. Needless to state, Hill and Foster did not give much weight to the idea that the contract type plays a major role in determining general corporate behavior. (90)

Although much of the research supports the hypothesis, there were exceptions. For example, Lt. Col. Alvin Ferhman (78) in a study from the Air Force University concluded that the use of incentives and the shift away from CPFF contracts saved billions of dollars. Major Julius Jones (79) in a masters thesis at the Air Force Institute of Technology concluded that incentives had attained their intended purpose and that for the most part profit was the key motivator of industry. He noted however that other factors also played a role. These included firm perpetuation, sales maximization and other socio-economic factors. Dennis E. Mundhenk also concluded positively. In reviewing the C-5A, the A-10 and the F-15 he found that the success of the programs derived from fitting the method to the program instead of the other way around. The C-5A failed due to the program being fitted to the method. The F-15 succeeded due to the tailoring of the method to the program. The message was that incentives can be used to substantially direct contractor motivations if they are used appropriately. (91) James Evans of the Defense Systems Management School struck a similar note. (93) Could the lack of goal congruence be due to the forcing on the contractor a particular contract type instead of tailoring one to its situation?

Oppendahl, a Commander in the USN, while a student in the Defense Weapons Management College, produced an interesting piece of research on contractor motivation that deserves special attention. He summarized the studies of Fox, Hunt, Fisher, Hill and Shepard, Cirone, LMI, Runkel and Schmidt, and Dixon. He concluded that incentives did not work. The main motivator was not profit. And the contract was not the major variable in contractor behavior. He developed a hierarchy of motivators similar in

concept to that of Maslow. His list included survival, profit, growth, market share and prestige. These varied over the stages of growth of the company. (116)

Dr. Raymond Hunt's research of the University of Buffalo deserves particular note. Rather than try to summarize the various papers only a few comments will be made germane to the current inquiry. Hunt, Rubin and Perry (117) found that over two-thirds of the companies made no adjustment to achieve maximum gain. There was little or no awareness of incentives presumed below first line supervision. Also, incentives do not generally affect resource allocation. And in Hunt, Near and Rubin (119), a picture is presented of a disjointed life within the organization. The goals of the organization were only weakly related to conceptions about what factors influenced project performance. Hunt concluded in his various papers that factors other than profit and the contract type drove the contractor's decision process.

Moore and Cozzolino of the Wharton School, in studying incentives from the perspective of risk assumption found that the traditional incentives were ineffective. The problem as they saw it was that the level of perceived risk was such that contractors acted to reduce risk and not to maximize profits. In their paper they quoted the Scherer study of '64 that contractors were not motivated under incentives to maximize fees. The drivers of the decisions, in their opinion, appeared to be the user costs function (need for new technology to win future contracts), taxes, and the uncontrollable cost components. (139)

McKean introduced some interesting ideas on why the government and

contractors might favor the CPFF contract. The major reason was that with the CPFF contract a wide range of behavior can be represented defensibly. In this fashion contractors can make investments to enhance future reputation, the government can make overruns defensible to the Congress. Since uncertainty was the major factor in determining behavior it should be recognized and contracted for accordingly. In short, uncertainty freed the government and the contractor from efficiency reviews. This was appropriate, he thought, since the Department of Defense was engaged in the defense of the nation and not specifically in saving the taxpayer money. He suggested that the contract document should be an enabling document. McKean asserted that uncertainty forces the contractor to be risk averse. (144)

Oliver Williams in an early Rand study concluded that the contractors' range of adaptive responses rendered direct control (through contractor financial and technical operations) and indirect control (through the contract type) ineffective. (145) Williams and Carr, in their '81 Darcom study of contractor motivation, noted: "It should be understood that the contract, in many instances, is not influencing performance to any great extent; contractor behavior is far more influenced by the contractor's other concerns." The study, which was a joint effort of the NSIA and the Army Research Office at Fort Lee, found that the particular motivations varied by size of the firm, product category, ownership and industry group. Both positive incentives and dis-incentives were considered. Much of the work was similar to that of Hunt. Industry felt the four strongest incentives were a fair and equitable contract, a guarantee of future business, program continuity, and a fair contract. Profit, cash flow and long term funded contracts were next in importance.

In assessing the literature what can be concluded? For one, it is overwhelmingly in support of the premise that multiple influences drive the contractor. Depending on the time frame (short run, long run), the nature of the company, the nature of its products, the size of the contracts, the general health of the company and the general economic climate, its goals will vary. The particular goals most mentioned were survival, prestige, technical competence, follow-on business, sales maximization, share of the market and long run adequate profits. Further, all contracts are the same administratively in the eyes of the contractor (this excludes CPAF); incentives are not passed down internally in the organization (this is a separate hypothesis and is covered in detail later). Performance goals seemed to be independent of the contract type. The contract type itself does not appear to have a dominant affect on contractor behavior. The larger the number of contracts that a company had the greater the validity of the observation.

THE NCMA QUESTIONNAIRES

Questions eleven, twelve and nineteen from Part I of the questionnaire and question one in the final portion were designed to test this query. Each is summarized below.

QUESTION ELEVEN: THE MANNER IN WHICH A CONTRACTOR MANAGES ITS PROGRAM IS AFFECTED BY CONTRACT TYPE.

The responses were highly reflective of a strong correlation between the contract type and how a company manages a program. Fifty-six percent felt strongly, 39 percent felt moderately, two percent minimally and the remainder, about one percent, not at all. This, in light of the literature,

was surprising. Perhaps the failure of the question to exclude CPAF or to be more specific on what was meant by management biased the results. At any rate, from this question alone, one would be forced to surmise that industry's management attention and style might vary by contract type. Before drawing any firm conclusion, let's look at question twelve that asks the same thing in a little different fashion.

QUESTION TWELVE: CONTRACT TYPE HAS WHAT EFFECT ON CONTRACT BEHAVIOR?
(A MAJOR EFFECT, A MODERATE EFFECT, NO EFFECT).

Again the data is the same. Fifty percent said a major effect, forty-six percent said a moderate effect and four percent said no effect. It would be interesting to correlate this to contract type to assess if the type of contracts handled influenced the perceptions. It would be one thing to have had only a fixed price experience and another to have had experience with a wide range of contract types.

Both questions eleven and twelve could also be stated that about fifty percent felt strongly that the contract type had a significant impact on contractor behavior and fifty percent thought that it had a moderate or no impact. Again the question must be raised as to the expectation set of the respondent. What did he or she perceive the question to be about? Why does the literature conclude that the contract type is not a determinant variable in contractor behavior and questions eleven and twelve seem to conclude that it is in fact an important determinant in how a contractor manages a contract? This is explored more in question nineteen.

QUESTION NINETEEN: DOES CONTRACT TYPE HAVE ANY CORRELATION TO CONTRACTOR PERFORMANCE? (YES, NO, SOMETIMES).

The responses for question nineteen are not as clearly in support of the contract type influencing management behavior. Forty-eight percent said yes, seven percent said no, and the balance, forty-five percent said sometimes. A pertinent fact to ascertain would be to determine the circumstances under which it does make a difference. When the question was asked a little differently in the final listing of hypothesis (using a scale from one to nine), the responses were quite different.

QUESTION ONE FROM THE FINAL LIST OF HYPOTHESIS: THE CONTRACT TYPE IS NOT THE DETERMINING VARIABLE AS TO THE OUTCOMES OF CONTRACTS. Note the difference in the question from eleven, twelve, or nineteen. Those questions inquired as to whether management varies its supervision by contract type and/or whether contract type has an impact on contractor management behavior. This question asks directly whether the contract type is the determining variable in contract outcomes. Seventy-two percent of the respondents checked a five or less where zero is strongly agree and nine strongly disagree. Forty-five percent were three or less. Conversely twenty-four percent were seven or higher. Thus, the data supports the contention that the contract type is not the determining variable.

From the above it appears that the contract type has an influence on contractor behavior. This is really what one would expect. Certainly a CPFF contract must be differently handled than a fixed price. But also it is apparent from both the literature and the questionnaire that the contract type is not the determining variable in contractor behavior. It is not the only, nor the most important input to the decision process. A lot probably

has to do with whether the motivators established in the contract are consistent with the motivational (often unexpressed) agenda of the contractor.

THE PILOT STUDY DATA

The Phase Two technical report, which observed contractor behavior through pilot studies of individual companies, addressed this query. The conclusions reached for the companies involved were that the contract type was not the determining variable. The contract type established the upper levels of expenditures and defined the goals through the specifications, program requirements, and schedules. But these are or can be the same regardless of the incentive. But the contract type did not have the determining influence on corporate goals and motivations which were determined primarily by factors outside the particular contract.

The companies studied varied in size, product lines, and particular contract mixes. But even for the company where a single contract represented over eighty percent of the sales the contract type did not appear to be an important factor in the key company decisions. Of course all decisions impact eventually on costs and profits and to that extent the contract type defines upper limits and profits. But the majority of the company administrative personnel did not know even the kind of contract. And if they had known, they would not have understood the significance of the contract type. This was as true for the engineering staff as for the director of manufacturing. As for the workers on the assembly line, they were not informed at all. A factor that contributed to this was the highly specialized nature of the government contract world. Those in the companies who dealt with contracts and the government procurement process were

recognized specialists. They were looked to as the experts. They handled the contract details. Nobody else had the background. And the experts were not in a hurry to let go of their expertise. Their power base was their special knowledge. And they protected it by maintaining the aura of complexity and confusion. This contributed to the problem.

The larger corporations revealed a somewhat different pattern but the effect was the same. For most of the contracts, only a relatively small cadre of personnel had any knowledge of the contract. Most of the corporate personnel were not familiar with the contract type. This was particularly evident when the contract size was relatively small compared to the total sales. The purpose seemed to be to get as much protection as possible at the negotiation table to minimize risk. Once the contract was in-house, the particular aspects of the contract tended to be lost in the general bureaucracy of the organization. The particular organizational behavior was that which represented the normal business patterns of the particular company. Budgets were established of course. These reflected the contract's pricing provisions and technical goals. But aside from these general and regular activities that would take place in any company, the details of the incentive contract did not filter down the organizational structure to the rank and file. It did not even get to the middle management. One would definitely conclude from the pilot studies that the contract type was not the determinant variable of contractor behavior.

INTERVIEWS AND WORKSHOPS

As noted earlier, workshops with industry representatives and with members of NCMA chapters were conducted over a two year period. In addition, interviews were conducted with experts from industry, government and a

variety of think tanks. One of the issues discussed was that of the contract type and its relationship to overall corporate behavior. As with any issue there was a diversity of points of view. Some of the comments are summarized below.

It made a lot of difference who one spoke to. The NCMA members that worked in the contract area tended to place a greater importance on the contract type than those who worked in other areas of the corporation. It was sometimes misinterpreted to mean that the contract type had no influence on the company's subsequent behavior in the discharge of the contract. That was not and is not the intended interpretation. One suspects that companies do behave differently with CPFF contracts than they do with fixed price contracts. But the contract is not a determining variable. The major determinants tend to be extra-contractual: That is they usually are concerned with something outside the contract.

When engineers, accountants, or financial managers were asked this question there was a common reaction. Usually those asked did not even know the full ramifications of the question since they did not understand the very basics of contract types let alone the rather complicated incentives. If the query was addressed to the CEO, the response was always that the particular contract did not alter the way he ran his business. He had overall goals; these did not shift by contract although the particular product areas might have different roles to play in the accomplishment of the goals. If the contract was large enough he stayed on top of it.

The organization of the company affected the response. Companies that had some type of organization matrix, had a clearer idea of the contract

type and its significance, at the program manager level. The program manager usually interfaced with a similar government counterpart. He often played a major role in the negotiation of the contract. Therefore he was familiar with the contract type and the ramifications. But the people in the functional areas through which he worked to get the job done were not. If there were several or more major programs with program managers, the confusion was often quite obvious to an outsider. When one contemplates the large number of contracts that a single large firm might have at any given moment, the importance of any single contract having a significant impact on the firm's behavior becomes suspect.

SUMMARY STATEMENT ON HYPOTHESIS ONE: THE CONTRACT TYPE IS NOT THE DETERMINANT VARIABLE IN THE CONTRACTORS' DECISION PROCESS.

If this research were to be done over, this question would probably have been worded differently on the questionnaires. In the interviews and the workshops, the ability to explore meanings provided for a clearer understanding of the thrust of the query. But on the questionnaire, it looks like there might have been some confusion as to the precise meaning of the words.

In the workshops several people took issue with the idea that the contract type had no impact on a company or that the contract type did not make any difference. That of course, as most observers would agree, would be absurd. No one is going to subscribe to the assertion that a CPFF contract and a fixed price contract encourages identical corporate behavior. That was not the intent of the hypothesis. The intent was to ascertain how important the contract type is in determining overall

corporate behavior. For example, how does contract type effect investment in facilities? To what extent does it have an impact on the formation of company goals? There is no argument that the contract type affects behavior. The question is to what extent does it affect behavior, and how much influence does it have?

The questionnaires, the pilot studies, the workshops and the interviews suggest the following:

1. There can be a strong correlation between the contract type and how a company manages a program (question eleven on the questionnaire).
2. The contract type can have a major or at least moderate effect on corporate behavior (question twelve from the questionnaire).
3. About half the time there is a strong correlation between the contract type and contractor performance (question nineteen).
4. The contract type is not, however, the determining variable in contractor behavior (question one, part I). A large proportion of the respondents indicated that the contract type was not the determining variable in explaining company behavior.
5. The contract type defined the parameters within which the contractor was to deliver the goods or provide the services called for by the contract. It established the upper limits of expenditures (not necessarily the target cost) and defined the goals through the specifications, program requirements and schedules. In a sense, the contract established a solution space for the performance of its contractual obligations.

6. As noted in the paragraphs on the questionnaire responses, the determining variables are more likely to be associated with the particular goals of the company. These would include such considerations as risk avoidance, survival, and adequate profit, follow-on contracts, technical supremacy and market share.
7. Certain contracts might be more appropriate for particular goal accomplishment. To fully appreciate the impact a specific contract type might have on company behavior, one would need to know the motivational agenda of the firm and the firm's managers.
8. Contract types, which impose goals that would be inconsistent with those already established by the company, would in most cases be ignored or abrogated in some fashion.

What are the implications of the above? It is this, one cannot assume that a firm's behavior can be significantly modified through a contractual arrangement. To be effective, a contract must be adapted to the particular situation of each company. Also it can be assumed that a company will not substantially modify its existing management style for a particular contract in the short run.

HYPOTHESIS TWOMOST INCENTIVE CONTRACTS END UP NEAR TARGET

Many of the fundamental issues, relating to whether incentive contracts work are keyed to this hypothesis. A general assumption is that if the final costs are close to the negotiated target, then the incentive contract was effective. But can we be so smug in this conclusion? Probably not. For example, there is evidence to suggest that when the DOD shifted in the early Sixties from CPFF contracts to incentives that target costs all increased. Maybe the contracts ended up near target because the targets had been inflated! Or are the contractors shifting costs among the contract mix to make a particular contract end up near target? Or perhaps the contractors were getting healthy through changes of one kind or another. Maybe ending up at a predetermined total is merely evidence that enough flexibility exists to make the numbers work.

In any discussion on efficiency of incentives it is well to bear in mind the original intentions as defined in the late Fifties and as implemented in the Sixties.

The single, most visible stimulants to reform were the overruns dramatized by the Vinson Committee Hearings and the renewed publicity which the subject received by the press and by academia. (2.5) For example, Scherer and Peck, in a study of thirteen systems procurements reported massive overruns. Much of the blame fell on the cost plus a fixed fee contract. But there were other stimuli. To quote from a research paper of that time period the major factors seemed to be:

1. Evidence that there had been greatly inaccurate estimates of costs and schedules under CPFF contracts,
2. The belief that under the incentive the contractor would be motivated to improve on these cost and schedule problems,
3. The assumption that the government would improve its own estimates of costs and schedules,
4. The belief that the budgetary system would operate more effectively,
5. The assumption that the pricing of change orders would be more realistic,
6. The belief that contractor efficiency would be improved,
7. A disillusionment that accurate costing and timely deliveries could not be obtained through certain legal remedies such as liquidated damages,
8. A long standing feeling that the government had injected itself too far into contractor surveillance and that the incentive contract would result in less surveillance,
9. A desire to motivate contractors to improve the quality of performance, and
10. A general dissatisfaction with the CPFF contract. (22)

The hypothesis that incentive contracts tend to end up near target needs to be evaluated within these general factors.

THE LITERATURE

As noted above, this question has several subtleties: Do contractors end up near target? If so, why? Is it because the targets are inflated? Is it because the contractors through changes or spares or the like manage to make the numbers come out at some predetermined total? Does he manipulate

costs among contracts? Is the Department of Defense able to accurately estimate "should costs"? The purpose of this hypothesis is to first establish whether incentive contracts do in fact tend to end up within the cost envelope of the contract. The reasons why are then explored in the following hypotheses.

Studies have been conducted both by the government and by private groups. The subject has been a favorite topic for graduate students at the masters and doctoral level. The various think tanks have also contributed. LMI and Rand particularly have been interested in this issue. The many papers, articles and books covers the time span since the Sixties. A review of the literature provides some interesting perspectives. The methodology was usually statistical in nature. There are also some based on a range of theoretical models. The researcher typically selected a time frame and a group of contracts and compared intended outcomes with actuals. Much of the data is suspect. The major studies are summarized below.

Bradley and McCuiston, in a '65 study of NASA contracts, found that a company's ability to control costs is limited. There are too many cost uncertainties. Therefore, the contractors set targets as high as possible. They found that there was little chance of negotiating fee arrangements that would truly motivate the contractor to reduce costs, the most likely outcome would be a cost over target. The exact amount of overrun depended on the penalty. (54)

The NASA sponsored Booz -Allen study of '66 listed several advantages and disadvantages. The benefits were an improved program definition, better communication among the parties, better discipline on changes,

and a more systematic monitoring and evaluation process. On the negative side the effectiveness of the schedule and performance elements bore no relationship to the dollar value of the incentives. And the effectiveness of the cost provision varied with the negotiated slope. They found that major overruns were usually traceable to subcontracts. Cost incentives seemed better than CPFF. (56)

In 1966, Deavers and McCall of Rand analyzed 252 late Fifties and early Sixties contracts. For the time period '62 to '63 there was no statistical evidence that high shares were more efficient or more risky. The differences between estimated and actual costs did not vary with the share rate. However they obtained different results for the period from '59 to '62. For that period the differences between the estimated and actual costs became increasingly negative as the share was increased. (58)

John Cross also looked at the problem in 1966. (59) Cross studied contracts in the period from '53 to '65. He wanted to evaluate the alleged ten percent savings to be made by shifting CPFF to incentive contracts. He concluded that the payments for risk bearing outweighed the increased efficiency. He asserted that the target costs were raised when the perceived risk increased. He felt that short run cost savings opportunities were too nebulous. Contracts did not end up near target because of the incentives. Similar comments were made by Professor Walter Hill while on duty with the Navy in '66. (61) His study of contracts had much to say of a broad nature. Much of the study will be referenced elsewhere particularly on overall effectiveness. But the spirit of his comments bear on the question at hand. Do incentive contracts end up near target? Without answering directly he suggested that if they did it was random. The

contract type was not the primary influence. Incentive contracts did result in improved program definition and cost control. But the size of the contract and the negotiated fee have more to do with behavior than the incentive structure. Hill was one of the few writers that recommended going back to more CPFF contracts.

In 1967 Colonel Troy Jones (70), then of the Air Force did a doctoral dissertation at Ohio State University on the effectiveness of incentives. Like Hill's work, the study was broad and its contents will be referred to in other parts of this paper as appropriate. But on the question of final costs, he concluded negatively. He stated that "there is no correlation between cost outcomes and contract types. When adjustments are made for changes and the different purposes of the contract, there was no significant difference of cost outcomes among CPFF, CPIF or FPIF contracts." The technical level of uncertainty within a program continued to play a much stronger role in cost outcomes than the contract type. However, he did find a correlation between shares and cost outcomes. The steeper the share the smaller the cost growth. Efficiencies, he thought, might be related to the improved management disciplines. In '68 LMI concluded similarly. No correlation existed between cost sharing ratios and cost outcomes. Incentives had not been effective in controlling cost growth. (70)

I. N. Fisher of Rand wrote several papers on the effectiveness of incentives. His theme throughout his works was the same. He recognized that DOD claimed fewer overruns through incentives. Also underruns were more common on FPI contracts than other types. But the value of the underrun did not seem to be related to the size of the contract type or

the slope. Since some contractors consistently achieved underruns, he concluded that underruns cannot be attributed to the contract type or the incentive. Also, there was a possibility that the apparent better cost performance was due to inflated target costs. On the positive side he conceded that incentive contracts might have resulted in better cost information, more realistic targets, and an improved attitude toward costs when compared to the CPFF environment. (58)

In '69 Alvin Fehrman, then a Lt. Colonel at the Air War College noted that incentives had saved the DOD two billion dollars since 1961. He attributed the savings partly to a shift away from CPFF contracts and partly to the increased use of competitive procurements. (78) Julius Jones and Russel Pierre in '69 agreed with Fehrman. Incentives were working. In their study of industry motivations 46% of responding firms indicated that profit was the basic motivator. Another forty-one percent indicated that firm perpetuation was the main goal. They reasoned, since there was a preponderance of underruns, overstated target costs were unlikely. The significant amount of the underruns should be attributed to the incentive goals. (79)

In 1970 Williams, Cummins, and Carter (80) disagreed with Fehrman and the Jones-Pierre studies. They concluded that incentive provisions had little influence on cost overruns. But they did find that cost growth and average cost modification varied with contract type. The average cost increased from FPI to CPIF to CPFF. They went so far as to suggest dropping incentives or at least de-emphasizing them.

A study of 2,683 incentive contracts that were completed from '63 to '70 was performed by John M. Parker in '71 while he was at the Air Force

Institute of Technology. He came up with some provocative findings. Firstly, contrary to the incentive theory, he found that contractors with share rates greater than 15% overran. It should have been the opposite. He also found that significant differences existed in average underruns and overruns for types of contracts and types of work. What was particularly discouraging was that CPIF contracts averaged greater overruns than that of CPFF or FPI contracts. Research and development contracts, as expected, averaged greater overruns than production. Finally, overruns tended to be associated with late delivery. (82)

In a similar vein, Captain Jerry Trimble in '71 found that contractors had not increased the efficiency of their labor or capital under incentive contracts. Also defense contractors had decreased their risk through diversification. (84)

Raymond Hunt of the University of Buffalo has written extensively on incentive contracts. In a '71 paper with Rubin and Perry he summarized his attitude on the fashionable incentives. Fundamentally, he argued that automatic, complex and inflexible FPI and CPIF contracts that assume a single dominant motivational variable (profit) cannot be effective. (85) J. E. Jones, then of the Army Command and Staff College writing in '71 added another dimension to the underrun-overrun problem. His research suggested that different commodity groups have different risks. The industries in high risk categories had distribution patterns that under-ran the targets. The companies in the low risk categories overran. (87)

In '73 M. W. Dixon studied naval fixed price incentive contracts while at the Navy Post Graduate School at Monterey, California. Dixon found

little supporting statistical evidence to support the basic tenets of incentive contracts. His study provided a wide range of conclusions. On the target cost issue he noted that no statistically significant relationship existed between the sharing rate and contract cost outcomes. Variations in cost overruns and underruns, cost of supplemental changes, and contract cost growth were unrelated to the value of the sharing arrangement. Cost savings advantages appeared to be fallacious and the value of incentives had to be judged on other grounds than cost savings and control. (89)

Professor Robert Crouch of the University of California in '78 reviewed the experiences of the Sixties and Seventies and drew several conclusions about target costs and underruns. He asserted that the Sixties were characterized by unrealistically high target costs. This produced underruns. In the Seventies however, due to increased competition and possibly the government personnel buying-in with the Congress the results were overruns. He felt there was a need for independent cost estimates if incentives were to work. (90)

In addition to these statistical studies, there have been several analyses based on theoretical models. For example, Feeney, McLaughlin and Woolson in '64 developed a simulated negotiation model where profit and share rate were tested. As expected from incentive contract theory both risk aversion and the expected profit varied with the share. This suggested that other things being equal the contractor would optimize the risk profit tradeoff. (125) (It ignored extra-contractual factors). In 1970, Schick and Pace presented a model for developing multiple incentives. They argued that multiple incentives could not work since the variables were not independent. In this context cost outcomes were not and could not be directly related to the proposed structure of the incentive. (134) David Baron in '71 of Northwestern

University utilized a mathematical model to demonstrate that risk averse firms appear to be the most efficient. If firms have the same cost, utility functions, and initial wealth levels then the firm with the most risky private sector profits would have had the lowest bid price with decreasing absolute risk aversion. More seriously, an increase in the share ratio would have resulted in higher bids. Therefore incentives may not be any better than CPFF. (136) In 1978, Professor John M. Cozzolino of the Wharton School argued a similar theme from a theoretical construct. Traditional incentives can't work. The problem is that the perceived risk is so high that contractors act to minimize risk and not to maximize profit. Consequently, targets are distorted and cost efficiencies improbable. The inference was that targets are inflated or that other actions are taken to minimize risk. (139)

An earlier work by John J. McCall in '64 of Rand came to similar conclusions. Using an economic model he tested Air Force contract data. He found that efficient firms were driven to submit higher than actual costs while inefficient firms tended to submit bids lower than anticipated. He felt that prior statistical studies were inadequate to demonstrate these conclusions. (143) Oliver Williams of Rand made a deductive analysis of incentives much like McKean. (144) He was skeptical that incentives resulted in cost efficiencies. He argued that the opportunities for adaptive response rendered the incentives ineffective. He also stated that the proposition that negotiated costs are not related to share rates was difficult to sustain. How this impacts the assumptions on target cost was not resolved.

In '76 Kenneth Gaver and Jerold Zimmerman of the University of Rochester studied the contract data from '69 through '74. They analyzed the data base

from three USAF contract forms. The final batch of data had 639 contracts. Of these there were 135 FPI and 57 CPIF contracts. Some of the findings are germane to the subject at hand. There was a slight tendency toward underrun for both the FPI and CPIF contracts. But the various incentives did not have a large impact on costs. (Is this consistent?) (104) Another particularly interesting study was an in-house effort by the AF Systems Command Staff at Andrews Air Force Base. The report covered the findings on 69 contracts in the '75-'81 time period. Of the sixty-nine, twenty came in under target, six came in at target, and forty-three came in over target cost. Of the forty-three, twenty-five were between target and the PTA and eighteen went to ceiling. Of the eighteen, eight of them apparently were in loss situations. The average price ceiling after modifications was 120.3%. Of the sixty-nine only thirteen had actually been completed. The balance were "far enough along to be able to estimate costs." The average share was 74/26, and the total dollars were 2.3 billion dollars. The range was from 114 thousand to 999 million dollars. The activities included ASD (\$11 million), SD (\$17 million), AD (\$13 million), BMO (\$13 million), ESD (\$4 million), RADC (\$9 million), and ESMC (\$92 million). The price ceilings ranged from 119% to 123%. On a percentage basis twenty-seven percent were overrun. (Cited from "revision to Data on Actual Performance on FPI Contracts" directorate of Contract Data Systems, headquarters Air Force Systems Command, Andrews AFB, Jan 15, 1982).

As to the meaning of the literature what can be stated? A number of observations are meaningful.

1. There is the continuing implication that if the final costs are near the target it is not because of the slope of the incentive feature.

2. Overruns occur more on CPIF contracts than FPI and more on research and development contracts than production contracts.
3. Underruns are more common on FPI than CPIF.
4. The amount of the underrun does not seem to be related to the slope.
5. There is some suggestion that cost growth is a function of contract type. But the evidence is not conclusive. And,
6. There is the suggestion that the increased risks of uncertainty are reflected in the contract type and the target cost. This would negate the need for efficient performance to achieve the incentive fee.

As to contract final costs, FPI's tended to end up near target in the years from '75 to date. In the time period from '69 through '74 there was a slight tendency for both CPIF and FPI to underrun. In another context the Sixties witnessed for the most part underruns or clusters close to target. Contrary to this experience the Seventies tended to witness slight overruns and/or clusters on the overrun side within the cost envelope.

The Department of Defense has published each fiscal year since the summary data on contracts. Similarly the General Accounting Office publishes a yearly report on cost growth of federal programs. For 185 programs in FY 1981, the DOD had an average cost growth of 88% based on original estimates and 52% based on the baseline estimate. There were 54 programs with cost growth in excess of 100%. The percentage of cost growth due to cost estimates for these 54 programs, was 21% for the Army, 4.6% for the Air Force, and 10.8% for the Navy. The impression is that the contracts ended up within the cost envelope. Why the contracts tend to end up near target is another matter.

A number of issues have to be resolved. Are the targets inflated?

The theorists and the research suggest yes. Do contractors have the flexibility among contracts to "manage the final costs to target"? The apparent answer is yes from both the research and theoretical models. Do changes give the contractor an opportunity to get healthy which thereby distorts the final cost picture? The answer is a qualified maybe. Certainly the potential is there.

THE NCMA QUESTIONNAIRES

Questions 23, 24, 25 and 26 from Part I and Question 2 from Part II are applicable, Question twenty-three read: "How often do your final costs, schedule and performance parameters end up within a range of plus or minus seven percent of target cost?" Cost, schedule and performance elements were treated separately. The answer spaces provided were: always, usually, rarely, and never. On the cost element fifty-seven percent said usually and nine percent said always. Thirty percent said rarely. Roughly two-thirds of the time the contracts ended up within plus or minus seven percent of the contract. That is very surprising. About the same pattern holds for the schedule and performance areas.

Question twenty-four read: "Why do most government and industry studies show that most incentive contracts end up near target?" The possible responses were five in number. These were: 1. Because targets were inflated, 2. Because with incentives there is more program definition and clearer description of the work statement, 3. Because in recent years there is less technological uncertainty, 4. Because of the improved skills of government and industry, and 5. Because of the adverse impact on the companies' reputation. The results of the questionnaire are shown in the brief table below.

The respondents were to check all appropriate answers.

	% Response
1. Inflated target	23
2. Better program definition and specs	52
3. Less technological uncertainty	7
4. Improved industry and government skills	24
5. Adverse affect on company	21

The results are informative. Almost a fourth of the respondents said there were inflated targets. Another major factor was better program definition and specifications, presumably through improved management. The improved skills are notable. Very few mentioned less technological uncertainty. By inference it is tempting to infer that there is therefore more uncertainty. As to the hypothesis on contracts ending near target it was surprising that some people did not state that in fact they do not. The question in itself was a test of that proposition. The question assumed that the premise concerning most incentives ending near target was valid. The respondents were asked to identify why. One gets an impression that there might be some validity to the claim.

Question twenty-five was short compared to 23 and 24. It read:
 "Targets of incentives are: 1. higher than targets of alternative contracts, 2. are the same as targets of alternative contracts, 3. there is no correlation between contract type and level of target outcomes, and 4. other. The respondents were to pick one answer only. The results are presented in the table below.

	% Response
1. Higher than alternative	47
2. Same as alternative	19
3. No correlation between contract type and outcomes	26
4. Other	8

Almost half of the respondents indicated that the targets of incentives are higher than alternative contracts. Twenty percent indicated that the contract type did not effect target cost and fully twenty-six percent did not think there was a correlation between contract type and target outcomes. This would be consistent with much of the literature noted above. Part one of the question lends credence to the qualms in the literature ab inflated targets. The question to be raised is why are they higher? Are they inflated or do they reflect perceived increases in risk? This will be addressed in question 26.

Number twenty-six analyzes the nature of higher targets. The question read: "How often are contractual arrangements: A. designed for intentional overrun (never, always, often, sometimes); and B. a portection against worst possible outcomes (scale from 0 to 9 with 0 being never and 9 always). The results are shown in the table.

	% Response
A. Intentional overrun:	
1. Never	23
2. Always	2
3. Often	19
4. Sometimes	42

B. Protection against worse outcome

	% Response	
0	7.6	Never
1	3.6	
2	8.4	
3	13.9	
4	8.7	
5	21.6	
6	10.8	
7	16.1	
8	6.0	
9	2.9	Always

On the intentional overrun, sixty-one percent of the respondents said often or sometimes. Almost a fourth said never. But that means seventy-five percent do. Almost twenty percent said often. This again suggests that actuals near target might merely mean that they were managed to an inflated cost level to assure technical achievement and if possible timely delivery.

The issue of protection against the worse possible events is revealing. This was used to provide insight on negotiation goals and behavior and to provide some feel for the validity of cost efficiencies. From the data it appears that there is some substance to the claim that aerospace contractors are risk averters. Almost sixty-eight percent of the group answered with a four or higher. Forty-seven percent are represented with five, six and seven. Again there seems to be evidence that efforts are made to inflate costs to provide protection.

Part II addresses the hypothesis directly. In Part II, the second question stated: "Most incentive contracts end up near target". The respondents were to score a 0 to 9 based on the degree to which they agreed with the question. 0 was to agree strongly and 9 was to disagree strongly. Sixty-seven percent of the respondents scored a five or lower. Forty-five percent scored a three or lower. About thirty percent scored two or lower. On the other end of the scale only ten percent strongly disagreed at the level of eight or nine. On balance there was a preponderance of sentiment for the hypothesis. Roughly thirty percent scored from six through nine. That is, about thirty percent are on the disagreement side of the argument. This is consistent with what has been described in the literature and in question twenty-three through twenty-six. A good question would be what the thirty percent's perceptions are, and, who are they?

Specific data on actual final costs compared to original estimated costs are very difficult to obtain. This is primarily because of the nature of the procurement process. There are numerous changes and the programs often go on for years. It is often several years even before a contract is finally closed out. In evaluating the final costs of a program, it is not unusual to discover that there is considerable disagreement as to what the costs actually were. Given this as a caveat, there are however, several conclusions that can be drawn from the questionnaire data. Targets tend to end up near target. More than two-thirds of the time the targets end up within plus or minus seven percent (#23). From question 24 they tend to end up near target due to inflated targets (23%) and better program definition and specifications (52%). In question 26 we find more about why.

Forty-seven percent said the targets are higher than alternative contracts. In question 26 the subject on high targets and intentional overruns was addressed. Surprisingly 61% said that contracts were designed for intentional overruns (often 19% and sometimes 42%). In part two of question twenty-six the respondents supported the often cited thesis that contractors are risk averters. Finally, from question #2, part two, there seemed to be a general sentiment in the questionnaire in support of the hypothesis. The minority that disagreed might be those with the large dollar system contracts.

THE PILOT STUDY DATA

The phase two pilot study provided additional insight into company intentions on the target cost of the contracts. Two models were presented. One for a relatively small company and one for a large company. Each is discussed. The contract for the small company was for a technological support item for one of the major aircraft weapons. It was a new item for the inventory. It had never been made before. The competition was keen between five companies for the development of the prototype. The company competed against the industry giants and won. In the fly off they were clearly the technical winner. They were awarded a contract for the development and production of the item on a fixed price incentive contract. Given the intense competition, the nature of the best and finals and the leakage among the competitors concerning what it would take to win, the target cost was very tight and possibly so low as to assure a loss. As noted in the phase two report there was a great deal of controversy and general disagreement within the company about the reasonableness of the costs. The president of the firm was confident that it could be done within the estimated target.

The cost estimator said he had a twenty percent safety valve built in. This was not known to other executives. The vice president of finance who had just joined the company thought that the target was "ludicrous" and impossibly low. The outcome of these opinions was such as to produce a finally negotiated fixed price incentive that had a very high break point of nearly thirty percent. At this time it appears that the final cost will be about twelve percent over target. But this could be very misleading, the real costs are obscured by the many changes to the program and the many reorganizations within the company. Unfortunately the procurement system permits manipulation and final costs near target can be fallacious.

On the model for the large prime contractors, the pilot study findings were essentially the same. But there were variations. Fundamentally, the contractors and the government spent all the money that was in the budget. Often there were additions or corrections to the scope of work. If there was money it was used. Further, the process of internal budgeting and the machinery of bureaucracy drove the contract costs to at least target. Another factor had to do with the corporate goal. The desire to assure technical achievement often meant that the spending continued to the limit. Often the dollars were optimized up to some point past target but within the cost envelope of the contract. The companies had difficulty in reducing costs in the short run. Short term goals were hard to put into practice. Budgets were in place for six months to a year. Managers were evaluated primarily on cash flow and/or meeting budgets. In all the contracts observed there was not a single sizable underrun on a CPIF development contract. The FPI

contracts for production tended to end up nearer target than the CPIF development contracts. This is about what one would expect. As a final comment on this matter, costs tended to the overrun side of target. There were greater overruns for CPIF than for FPI contracts. Most of the contracts were brought in within the cost parameters of the contract. To state that they ended up near target would require a clearer definition of the intent of the word near. Certainly it was not within plus or minus seven percent as used in question twenty-three. If the inquiry were to have read close to target (i.e. plus or minus twenty percent) then the appropriate conclusion would be that the hypothesis is valid. Taken within the general conception of an overrun being massive (the Scherer and Peck models) then the contracts did in fact end up near target.

INTERVIEWS AND WORKSHOPS

In attempting to assess this issue in the workshops and interviews several facts were taken. What are your negotiation goals? If you had a choice would you underrun or spend money to improve the technical base of your company? What is the impact on future negotiations if you have a major underrun? From these and similar questions a model of behavior emerged. Again generalizations are dangerous. And this is one. But it seems to explain much of the behavior observed. It goes like this. If you underrun substantially you pay a price in future negotiations. The customer discounts your bid on the assumption that it is padded. If you seriously overrun you create a bad problem for the customer and your own company. Eliminating the impact of inflation and changes, most of the comments from the companies indicated that dollars are optimized within a reasonable overrun from target.

This was particularly true of the several fixed price incentive contracts observed that had relatively high ceiling and flat shares on the overrun side. These tended to run to the ceiling.

For the most part, the results of the sessions supported and clarified the results of the questionnaires and the pilot studies. The competitive environment just about makes it impossible to substantially underrun a contract. And if a company, for whatever reason, finds that it might have a substantial underrun coming it often decides to spend the money on technical development or in some other beneficial manner. The firm often benefits more in the long run by incurring costs rather than reducing them.

SUMMARY COMMENTS ON HYPOTHESIS TWO: MOST INCENTIVE CONTRACTS END UP NEAR TARGET.

In retrospect part of these questions should have been worded differently. What is near target? The intent was to measure whether incentive contracts work. One obvious measurement is whether they have eliminated the massive overruns of the Fifties and early Sixties that led to incentives in the first place. Perhaps the question should have alluded to the cost swing or the cost envelope. Nevertheless, the basic inquiry on whether contracts tend to end up near target is answered affirmatively. Questions 23, 24, 25 26 of part one and question 2 of part two are very revealing. The questionnaire data was combined with the literature, pilot study and interviews; a definite organizational pattern emerged. A list of some of the implications are as follows.

1. There does not seem to be a correlation between the share line and cost outcomes.

2. CPIF contracts overrun more than FPI contracts.
3. Contractors tend to spend to at least target. How much over target is a function partly of the type of contract. The type contract is usually reflective of the nature of the end product being bought.
4. Designing contracts to protect against overrun seems to be a viable part of the aerospace strategy. With best and finals and increased competition this is not a surprise.
5. Targets of incentives tend to be higher than alternative type contracts.
6. Contractors are risk averters as demonstrated in the goals of getting as high a target as possible for the incentive.
7. Actual costs are hard to accumulate and even harder to assess due to the complexities of the procurement bureaucracy.
8. If by near target, it is meant within the cost envelope of the contract, the answer is assuredly positive. Incentives tend to end up near target.
9. They end up near target because the pressures of the system drive them to at least target. It is not possible to effect cost savings in the short run. Also it is not advantageous to follow-on contracts to have significant underruns. So that even if a significant underrun was feasible it would probably be undesirable. How far one overruns is a function of the competitive process, the penalties imposed for penetrating breakpoints or ceilings, the current health of the company, and the benefits associated with the proposed additions of costs.

HYPOTHESIS THREE

THE TARGET COSTS OF INCENTIVE CONTRACTS ARE HIGHER THAN THE TARGET COSTS OF ALTERNATE CPFF CONTRACTS.

A number of the findings from Hypothesis Two are applicable. For example, contractors inflate targets if possible to provide against overruns, contractors are risk averters, and contract structures are designed for intentional overrun. The purpose of Hypothesis Three was to ask the same kinds of questions as in Hypothesis Two.

The literature base was sketchy. And the pilot studies, because of their narrow base and the programs studied added little. However, the interviews and the workshops did provide some rich data for study.

THE LITERATURE

In a 1943 article, Glenn Loyd discussed the advantages and disadvantages of the incentive type contracts used during the Second World War. (22) Among the disadvantages stated was the tendency of the contractor to inflate the target costs. Also Douglas Egan, in a doctoral dissertation at Berkeley, argued that adjustments to alleviate risk are part of the unique economic market arrangement. He thought that the uncertainties were unusually high due to the sudden shifts in demand. To reduce the risks, the buyer and seller worked more closely together than in the traditional markets. (39)

In addition there are numerous examples from the General Accounting Office of alleged inflation of estimated costs. For example, an early study in '59 of a fixed price incentive, charged Lockheed with overstatement of its costs. Lockheed thereby artificially increased its targets. (51) In this vein see also the US Government Accounting Office study in '77 of

a Northrop fixed price incentive. Again the charge was inflation of the target. (166) It is not reasonable to take isolated cases. Nevertheless, the perception of the officials of the GAO in several brief discussions inferred that it was not an uncommon problem.

Cross, in his '66 paper, suggested that apparent contractor efficiency was a result of the shifting of costs among contracts. He also inferred that contractors' efficiency was partly related to inflated targets. (59) I.N. Fischer wrote several papers on incentives. His theme was fundamentally that it was difficult to attribute the results to increased efficiency. He was not sure whether the underruns, attributed to the use of incentives, resulted from real efficiencies or from inflated target costs. (76) On another perspective, Julius Jones and Russell Pierre in 1969 thought that they "worked". Presumably in that context the targets were reasonable. (79) Williams, Cummins and Carter in a 1970 paper disagreed. They concluded that incentive provisions had little effect on cost outcomes. The average cost increased from FPI, to CPIF, to CPFF. And more specifically, contractors must have shifted the risk to the government in some fashion (maybe inflated targets). (80) Parker, in '71 in his study of outcomes on some 2,643 contracts, made several observations on the behavior of costs. Of interest is his finding that there was no evidence to support the popular belief that contractors "get healthy" through changes. He found that overruns and underruns varied by contract type. The CPIF averaged substantially greater overruns than FPI or CPFF contracts. Underruns tended to be associated with early delivery. (82) What he might have missed is that if contractors inflated targets then they would not have had to "get healthy" through changes.

His findings suggest inflation of targets. Dixon in '73 on commenting on the two possible effects of incentives said that the bias effect resulted from the tendency of contractors to propose targets that were inflated. (89) Crouch in '78 argued that the 60's were characterized by underruns and the 70's by overruns. The Sixties' overruns were due to inflated targets. The overruns were due partly to the increased competition and partly to buying-in. He argued that the problem with incentives has been the inability to get sound targets. (98)

When Gaver and Zimmerman looked at 639 Air Force contracts of the '69-'74 time period they found that there was a slight tendency toward underrun for both FPI and CPIF. (104) What does this tell us about the targets? Were targets for FPI and CPIF contracts inflated? Were they accurate and did the contractor choose to incur costs rather than reduce them? Or didn't the incentive matter since in the short run they were not attainable?

In the early 50's when Secretary McNamara decided to shift CPFF contracts to incentive, the then existing CPFF contracts had to be re-negotiated. What happened to the targets when they were converted from the CPFF contracts to incentives? Did they go up or down? They went up. Professor Roberts of M.I.T. with J. Barry Short studied contracts in this transition. Two things tended to occur. Contractors stalled in the negotiations until an adequate cost data could be gathered. Therefore many contracts were not definitized until over sixty percent of the cost had been incurred. Secondly, contractors also refused to negotiate steep share lines under conditions of high risk. They positioned themselves for

minimum risk. Normally the targets went up. (141) (As an aside, the author at that time was involved in assisting DOD buyers to renegotiate the CPFF contracts. It was very common for the contractor to escalate his targets substantially.) Assuming that the incentive contract was novel at the time and that the contractors were unilaterally being forced into accepting them, this behavior was not surprising. However it does lead one to suspect that the targets of the CPFF contracts were perhaps optimistic. But it does not necessarily mean that those negotiated for the incentives were inflated.

John J. McCall of Rand in a '64 paper through a statistical model concluded that efficient firms are driven to submit higher than actual target costs. Inefficient firms tend to submit bids lower than anticipated. In this light, the degree of inflation would be a partial measure of the potential efficiency of the firm. (143) McKeen agreed. (144) He argued that with the CPFF contract the bias was to submit targets that were lower than anticipated. With incentives the bias was the opposite. Finally James Evans in '74 of the Army, investigated the potential impact that competitive prototype procurement methods might have on the use of the incentive contracts. He concluded that the hope for the follow-on contract might result in a buy-in. Under such conditions, the potential of the incentive was negated before the contract was even signed. (158)

Is there an answer from the literature? Probably yes. One would normally expect contractors to obtain as high a target cost as possible. That is the nature of the negotiation "game" but in that context, since 1962 under public law 87-653, contractors have been required to submit complete

cost and pricing data and to certify as to its accuracy, completeness and currency. Given this requirement there probably has been a substantial elimination of outright fraud. But there is still room for optimistic as opposed to pessimistic estimates. And in the arena of the unknown-unknowns who really can be the judge? Contractors, when they converted from CPFF to incentive contracts, increased their target costs. This was primarily in the Sixties when underruns were common. In the more competitive environment of the Seventies, overruns were more common. This was probably because of the tight targets. It was noted in Hypothesis Two that there did not seem to be a correlation between share and cost outcomes. This is probably because the dominant motivation is pricing flexibility. This depends on the competition or lack thereof. If targets are relatively loose and the shares high on the underrun side there might be some motivation to come in below target. But when targets are tight or more likely, impossible to attain, the principal intention is to get protection on the overrun side. Contractors get targets as high as possible.

THE NCMA QUESTIONNAIRE

Two questions addressed the hypothesis. Question twenty-five read: "Targets of incentives are higher than alternate contracts, are the same, or there is no correlation " Question 2, Part Two read: "The targets of incentive contracts are higher than alternatives." The respondent was to give an answer from 0 to 9 with 0 being strongly agree and 9 being strongly disagree. For Question 25 the response pattern was as follows.

RESPONSE PATTERN

	% RESPONSE
1. Higher than alternative	47
2. Same as alternative	19
3. No correlation between contract type and contract outcomes	26
4. Other	8

In support of the hypothesis 47% said that they thought that the targets of incentives are higher than those of alternative contracts. Twenty-six percent did not think there was a correlation. That is, the targets were determined by factors other than the contract type. Nineteen percent said that the targets would be the same regardless of the contract type. On the surface it looks like about fifty percent of the sample thought that incentives have higher targets. Why? Is it because of increased risk? Or is it to take advantage of the increased profit of the incentive? If the final contract costs are near target or overrun, the latter possibility seems negated. Perhaps it is to cover the increased risks. A third possibility would be to maximize cost dollars. More on this later.

The response to Question Two was as follows:

<u>Value</u>	<u>% Response</u>	
0	12	Strongly Agree
1	6	
2	11	
3	8	
4	10	
5	15	
6	6	
7	9	
8	8.6	
9	6	
		Strongly Disagree

Sixty-three percent recorded a five or lower. Thirty-four percent, a six or higher. There was a pretty even distribution. More than half thought that targets were higher. Are the large manufacturers different than the small? What about the differences between the airframe and the missile producers? This needs to be pursued.

THE PILOT STUDIES

Only a limited insight was gained on this issue during the pilot studies since very few CPFF contracts were observed. However, through dialogue with the personnel, some observations were obtained. One example arose with the small company that was in the planning stage for an incentive. When a CPFF versus a CPIF was considered the target for the incentive was higher. For more risk there was a higher target cost. Since it was thought that adequate compensation could not be obtained from the proposed fee, the added return was sought through the cost area. For the large companies very few comparisons were available. Heresay in the organization however, was available. The general scuttlebutt was that cost contracts were soft type contracts. That is they had more flexibility for absorbing costs. For CPFF contracts there was a normal attitude to be optimistic. This benefitted both parties. In a competitive environment, the targets were determined primarily by what the traffic would bear modified by what it would take to win. There was a lot of leakage from the marketplace and from the customer on the approximate numbers for the procurement. Companies were familiar with the bidding history of the other players. They were aware of approximate overheads and related capabilities. "Lowball" numbers were fairly accurate. These factors rather than the contract type were the major determinants of the target costs and the contract structures.

INTERVIEWS AND WORKSHOPS

This question of CPFF and incentive targets did not come up very often in the interviews or workshops. This was primarily because of the limited time and the pressing interests of the parties to discuss other elements of the research. It was also a difficult topic to address and to obtain replies to. In essence, there was a tinge of unethical practice suggested. That is, it was alleged that contractors inflate their target costs. It is difficult to get contractors to discuss such allegations. When the subject did come up the response to higher targets (not inflated) was that, compared to CPFF, the CPIF had more risk. The higher target was a recognition of the increased risk.

The point of view of the government and that of industry varied substantially on this issue. Government procurement personnel almost invariably thought that contractors inflated their target costs. It was, to quote "part of the game". "They put it in so we can take it out." This usually came up when the talk got around to discussing whether contractors were honest. For the most part government personnel had a "healthy distrust" of contractors' cost data. Everyone was not dishonest but they did not know who the good guys were. When asking the question of whether contractors inflate the targets of incentives, the government team usually answered in the affirmative. It is difficult to fully explain this general sense of distrust. But it certainly exists, and it is widespread.

SUMMARY COMMENT ON HYPOTHESIS THREE

The literature infers that the targets of incentives are higher than CPFF contracts. Also the targets of an FPI would probably be higher than

the comparative CPIF in the same situation. Similarly it is likely that the underruns of the Sixties were due to inflated targets. Then, the increased competition and improved program definition built into the procurement system in the Seventies produced tighter targets.

The questionnaire data suggests that the targets of the incentives are higher than alternatives. This was supported by the pilot studies and interviews and workshops. The key question is, why are they higher? Are they merely inflated (assuming the competitive situation allows this) or does the increase translate into increased risk associated with the contract type? This is pursued in the following hypothesis.

HYPOTHESIS FOUR

THE MOST SIGNIFICANT FACTOR IN DETERMINING THE TARGET COST FOR NEGOTIATION IS WHERE THE COMPANY EXPECTS TO END UP.

Are contractors minimizing risk at the negotiation table? The author's own twenty-five years of experience suggests that the negotiation session often makes or breaks the firm. "Get it at the negotiation table" is the byline of the industry. Do companies therefore propose targets that are inflated? Does this estimate then represent the prime driver for the contract type and the contract structure? For example, in a tight competitive procurement, how does the company handle the highly probable overrun? It is hypothesized that the impact of the overrun is minimized by an appropriate contract structure. These and similar issues are pursued within Hypothesis Four.

THE LITERATURE

There has not been much written on this issue. Whereas there are literally dozens of studies on the incentive contract, there are only a handful on this particular issue. Bradley and McCuiston in '65 noted "that a contractor is not particularly motivated by a fee that he thinks is greater than fair." They argued that the possibilities for controlling the cost outcomes is insignificant to the cost uncertainties. Therefore, in negotiation, the contractor seeks the most desirable position in terms of the cost uncertainties. In other words, he tries to eliminate or minimize the risks at the negotiation table. Or put another way, he wants to target at the pessimistic point. He goes on to note that tight targets are completely incompatible with strong incentive provisions. (54)

John Cross in a '66 study of incentive contracts alluded to the problem. He found that contractors tended to accept high share rates for low risk contracts. It should be the other way around. (59) Professor Walter Hill of Syracuse University in a '66 study attacked the question directly. He concluded that firms seek long run satisfactory profits. The contractor attempted to insure satisfactory profits at the bargaining table. Also, when a CPFF contract mix was available, there was a tendency to lump personnel and overhead costs on the CPFF contract. (61) I.N. Fisher of Rand studied incentives over several years. He had many qualms about them. One of his major concerns was the source of the apparent underruns. Did they occur through efficiency? Or were the targets overstated? That is, was the profit and the cost protection secured at the negotiation table? He emphasized that effective incentives can only work if there are accurate estimates. (76) Williams, Cummins and Carter concluded that incentives have little influence on cost outcomes. They reported that contractors, in some fashion, must be shifting the risks to the government. Do they do that at the negotiation table? (80) Similarly, Cozzolino of Wharton in a '78 paper pictured the contractor as a company that attempted to minimize risk. The firm was a risk averter. It shifted or avoided risks whenever possible. (139) Edward Roberts in a joint paper with Barry Short found that "there was an increased relative payoff for skilled negotiation rather than technical performance." Contractors appeared to be more motivated by the potential large losses under the incentive than the possible gains. (141)

McKean presents an interesting argument for the CPFF contract. Since uncertainty is so high in defense acquisition, the CPFF contract was attractive to both parties. Since large firms were risk averse, both the

government and industry needed the CPFF approach. If this was valid, what happened to the risk incentive? Is it shifted during the negotiation session? (144) About the same argument is offered by Oliver E. Williams of Rand. (145) Uncertainties are paramount in aerospace. Contractors have handled them through a large array of adaptive responses. The negotiation session is one of the basic adaptive tools for response.

The research aside, the common wisdom of the industry is "to get it at the negotiation table." More on this below..

THE NCMA QUESTIONNAIRE

Question thirty-nine from Part One and Question four from Part Two are applicable.

Question thirty-nine read: "The major negotiation goal is protection on the overrun side of the targets." This is true: most of the time, sometimes, rarely, and never. The results were:

<u>Choice</u>	<u>% Response</u>
Most of the time	60
Sometimes	28
Rarely	6
Never	6

As the data indicates, the hypothesis was strongly supported by sixty percent of the respondents. Another twenty-eight percent indicated that it was true sometimes. All in all about eighty-eight percent of the time, there seems to be a high probability of it occurring. Another measure is the very low percentage of it never being true. How often can the contracting officer reject it as a possibility? Apparently rarely, and only at his peril.

Question number four read: "The most significant factor in determining the target cost for negotiation is where you expect to end up. On a scale of zero to nine provide your choice. Zero is agree and nine is disagree." The results were as follows:

	<u>Value</u>	<u>% Response</u>
Agree	0	28
	1	12
	2	16
	3	9
	4	7
	5	5
	6	2
	7	4
	8	6
Disagree	9	7

Again, the evidence is quite supportive of the hypothesis. Seventy-nine percent answered five or lower. More importantly, fifty-six scored a two or lower. It appears that the dominant factor, in establishing the negotiation position, is protection against uncertainties.

THE PILOT STUDIES

For an FPI, one of the small companies (fifty million \$ contract) proposed the target cost at the estimated pessimistic final cost. They did so to optimize protection. If they could have, they would have set the target cost even higher. The best and finals and the dollars available in the budget changed that. In reality the competitive process forced the

contractor to set the target cost unrealistically low. To offset this, they negotiated and obtained a price ceiling of 130% of the target cost. This was about what they thought the final costs would be if all went wrong. In fact they ended up about 112% of target.

The in-house observations of the larger companies provided a wider perspective. The bidding targets were determined by the competitive pressures, the anticipation of changes, the follow-on potential, the size of the contract and the current capacity. Inflationary pressures were also important. Thus, the companies provided an estimate of the most pessimistic costs. Every effort was made in the negotiation to at least cover the worst case situation. The drivers for the negotiation session generally were risk reduction or aversion, profit satisfaction and technological maximization.

INTERVIEWS AND WORKSHOPS

The informal discussions established credibility for the hypothesis. The negotiation team's main goal was most often to protect the company against massive losses. The downside risk was often much greater than the upside profit potential, and there was an administrative lid on how much could be earned. But there was not an administrative floor on how much you could lose. In the current atmosphere of competitive procurement, the target costs of the development effort are often unrealistically low.

If someone needs the business badly enough, there is always the likelihood of the buy-in. As has been seen, the buy-in is considered to be a reasonable strategy. It is apparently widely practiced. A popular solution to tight targets is an incentive contract structure that would reduce the impact of the overrun. Thus shallow shares or more importantly high ceilings are sought.

Again the place to win or lose is at the negotiation table. So goes the industry common wisdom. This was commented on time and time again.

SUMMARY STATEMENT ON HYPOTHESIS FOUR

A contractors' behavior will vary with the general economic conditions and with their own economic health. And the goals of the corporation are often diverse and complex. But the dominant goals reported were survival, long run profit, technical supremacy, company prestige and follow-on business. And, given the large downside risk and the minimum upside potential, it is not surprising to find risk averters and profit satisfiers among the large companies, as is so often reported by prior researchers. Given this element of uncertainty that is associated with technical and business unknowns, it is probably to be expected that companies seek protection from destructive, unmanageable overruns. The easiest place to handle the problem is at the negotiation table.

HYPOTHESIS FIVE

THE GOVERNMENT IN ITS ADMINISTRATION OF THE CONTRACT DESTROYS ANY OPPORTUNITY FOR THE INCENTIVE TO WORK:

There are several requirements that must be met for an incentive to function as a motivator. It must be clear what the rewards are. It must be achievable, and the rewards must be given in a timely fashion. Hopefully, the process of making this work does not cost more than the potential benefits associated with the increased performance and the cost efficiencies. Hypothesis Five and Six investigate these issues. Is the administrative process such as to make the incentive contracts inoperable? Does the administrative process destroy the motivation and does it cost more than it saves? The literature on the effectiveness of incentives has been relatively quiet on these issues. There is not the wealth of studies on these particular areas as on the general question of efficiency. But as evidenced by the few studies made, there are some serious problems in the administration of the incentive contract.

THE LITERATURE

In 1963 the American Marketing Association sponsored a series of conferences on incentive contracts. In one of it's programs held in New York, Lindesko of RCA spoke on the administrative aspects. Also, Mr. Francis Daigle of GE spoke on post contractual problems. Nineteen sixty three was a long time ago.

Are the problems still valid? Maybe so. Mr. Lindesko identified seven problems. These were:

1. The definization of the contract after performance had been substantially completed.

2. The refusal to adjust the target cost when the additional costs incurred were the government's fault.
3. The government delays of all kinds.
4. The refusal to write schedule or performance incentives.
5. The inadequate program definition.
6. The unattainable targets and goals, and,
7. The lack of adequate specifications.

Items four and five probably have been partially remedied. The others probably still have some validity.

Daigle listed some fifteen problems. The practitioner will find them familiar. These were:

1. Fiscal and single year funding,
2. Changes,
3. Termination,
4. Changes in the basic terms,
5. Disagreement in performance scoring,
6. Changes in personnel,
7. Final close out (too long from incentive earned and often punitive),
8. Audit (took away the earned fees),
9. Uncertainty of rewards (proof of 100% contract fulfillment),
10. The renegotiation of board's attitudes,
11. Punitive negotiations,
12. Successive profit squeezing,
13. Yesterday's performance becomes tomorrow's standard,

14. The statistics game on the number of CPFF and CPIF contracts, and,

15. The lowering of fees through negative incentives. (20)

In a paper on the use of incentives in aircraft procurement, Redden in '65 listed some nineteen recommendations and conclusions. Among them were some that pertained to contract administration.

1. The area of subcontracting is often neglected.
2. Cost audits should be based on direct costing rather than absorption costing, and,
3. Regardless of the method used in the utilization of incentives, extreme care should be taken to insure that the government's controls over the contractor are kept to a minimum. (52)

Newsletter Number Ten published in May of '63 was the final report of the AFSC Management Conference held in Monterey, California hosted by AF General Bernard Schriver. There were fifty-two projects set up to improve acquisition. One of the major focuses of the time was the "new" approach to contracting, the incentive approach. Consequently the topic flavored all the undertakings of the group. Another major concern was the increased burden of paperwork placed on the contractor. A similar concern was the increased involvement of the government in the acquisition process. Toward these ends several projects were established. They recommended:

1. Contractor reporting requirements be standardized and reduced.
2. The reports required be sharply curtailed.
3. The elimination of inspection and audit requirements in FP contracts.
4. The reduction of controls over the contractor where there is effective subcontract management.

5. The standardization and reduction in regulations.
6. The relief of top management from program details.
7. The reduction of the procurement cycle time.
8. The reduction of make or buy requirements. (12)

Apparently nobody was listening, many of these problems are still around. Even worse they are being rediscovered.

The 1962 original incentive guide is a helpful document. It listed several administrative requirements for the contract to work. These were:

1. There had to be increased communication among the functions of the contractor organization.
2. The accounting systems of the contractor had to be able to detect problems soon enough so that they might be correlated.
3. The reporting systems had to relate cost, schedule and performance data.
4. It was imperative that the government improve its administration. .
It had to reply promptly to requests for approval or direction.
5. Reps had to go out promptly. Contract administrative personnel should expect that their activities would be viewed much more critically.
6. Industry's greatest concern was that the government's ineptness would negate its opportunity to make the incentive work. (18)

In 1967 Herbert Roback in a paper presented to the American Bar Association, traced the history of the truth in negotiation in legislation. (13)
He recalled the impact that Karl Vinson, a pioneer of profit control, had on government procurement. Vinson was for a long time Chairman of the Armed Services Procurement Committee and as such, was adamantly opposed to incentive

contracts. He thought that they were a give-away. He thought that contractors made profit merely by inflating the targets and not by earning them through increased performance. As a result he sponsored the Vinson-Trammel Act and the Smith-Vinson Bills on the eve of World War II. In later years he led the fight for the Renegotiation Act of 1951. Between 1957 and 1963 the Controller General published eighty-two reports to the Congress on over-pricing of negotiated DOD contracts. The atmosphere created by Vinson toward the aerospace industry through his allegations of dishonesty fueled the fire for close supervision of contracts and helped lead the way to the adversary positions that are sometimes found today. Much of the administrative process had been imposed on the premise that it was needed. (13)

In a '66 paper by Kennedy, Nolan and Bass, the objectives of the incentive contract were evaluated. It is interesting to note that one of the motivations was to eliminate much of the then prevailing checks and audits. To quote: "The interest in incentives seemed to stem from several factors. This included a long-standing feeling that the government had injected itself too far into contractor surveillance and that the incentive would result in less". (22)

Another interesting historical document was a document prepared by the Army in '57 as a guide to the contract types. (32) In its comments on incentives it listed the advantages and disadvantages. The disadvantages they felt outweighed the advantages. They listed several items. Some of them bear on the problems of administration of the contract. These were:

1. Incentives require complex accounting systems,
2. They increase the cost of administration,

3. The government assumes part of the risk,
4. It is difficult to establish targets, and,
5. They require experienced and honest contractors.

In its infancy state, the stage was set for the problems of complexity and administrative headaches. The contracts would require more administration. How much more? It would increase the cost of administration. How much? On the same point the Air Force, in its '58 guide to contract types said the following, "Under Title Ten of the U.S. Code such a contract cannot be used unless it is first determined that it is likely to be less costly than other types of contracts and that it is improbable to secure the goods and services without the use of such a contract." (30)

Professor Walter Hill in '66, in a study for the Navy, noted that the government personnel are inadequately trained on contract administrative procedures. Contracting officers were too conservative and inadequately trained in cost estimating and pricing. Cost share ratios and fees were too low because contracting officers were afraid they might be viewed as poor negotiators. Subcontracts were inadequately administered. Plant representatives were too inflexible and possessed an audit bias. (61)

LMI in a '67 study (67) highlighted several administrative deficiencies. There were gaps in implementing policy at the operative level. The time delays in consummating contracts were inordinate. Contractors were not kept informed on a timely basis. There was an attempt to force conformity in the management of firms. And finally, the overhead rates that were developed for CPFF contracts were being applied to incentives.

On the other side of the coin, Colonel Troy Jones of the Air Force, in a comprehensive doctoral study in '67 found that incentive contracts had resulted in improved administration of contracts. They had improved administrative discipline. (70) In another LMI study in '68 it was reported that the administrative process had cost more with incentives but they had not worked to the government's disadvantage. The contract should have reduced the administrative problems since the work statements were better. (74) Fisher of Rand in '68 concluded similarly. The government assumed the role of a conscious buyer rather than a benevolent benefactor. (58) At a later date, Commander Oppendahl in a '77 analysis generally condemned incentive contracts. Along the way he commented on the administrative aspects. He concluded that the government-industry interface was strained by formal regulations, by Congressional action and by public opinion. (95) And Barry J. Shillito, in talking on the management of weapon systems, felt that the steps taken in the Fifties and Sixties were in the right direction but that they "may have moved so far as to deprive us of the appropriate flexibility to allow the most effective acquisition to take place." (114)

Professor Ray Hunt has produced some of the most thorough and provocative work on the analysis of incentives. For the most part he had disavowed the traditional incentives and had recommended the use of the award fee type contracts. In his studies he reflected on the administrative aspect. (117) The companies he studied had no special administrative techniques for incentives. He also concluded that the government should reduce its direction and surveillance. In a similar tone, in an early '64 study, W.C. Frederick in commenting on the administration of contracts said "They were often awarded before the requirements

were known and that the government constrained inventiveness and ingenuity through their administration." (124)

In one of the very few studies to look at the administrative aspect of incentives, Major Russell Cleveland of the Army investigated the interface between a project manager and the defense contractor. He concluded that there were deficiencies in the administrative interface. The Army was not using the services of DCAS fully. (165)

Williams and Carr, in their '81 Darcom study of contractor's motivations, made some observations on the problems of administering contracts. Under the section on disincentives they reported that both government and industry in separate questionnaires ranked the paperwork problem as the greatest disincentive. Also noted were delays and discontinuous relationships. On the subject of incentives they found that they could be effective if properly applied. To do so, one had to match the motivation of the company and the pricing arrangement to the situation (APRO 80-06)

To date, the literature has not provided an adequate base to fully assess the nature of the problems associated with the administration of the incentive. However, the NCMA questionnaire, the pilot studies and the industry workshops and interviews did provide a rich source of information.

THE NCMA QUESTIONNAIRES

Five questions addressed the hypothesis. Question forty looked at the impact of changes; Question forty-one attempted to identify particular administrative practices that have proven destructive, and Questions forty-two and three compared the costs of administration with the benefits. Finally, Question five of Part Two went directly to the heart of the issue. Does the

administrative process destroy the potential of the incentive? Since Questions forty-two and three dealt primarily with the costs of administration they are covered under Hypothesis Six.

Question forty-one read: "The administrative burden of the government contractor is reflected primarily through changes, too many audits, the attitude toward the contractor, the timeliness of responses and handling of paperwork, regulations and other." Respondents were to rank the three most important.

The most persistent problem appearing was the government's inability to resolve problems in a timely manner. It was closely followed by the impact of regulations. The third most frequent factor was changes. Attitudes and the frequency of audits were weak in comparison. This was surprising because of the large number of comments on audits confronted in the workshops and interviews.

Question forty read: "The government eliminates much of the opportunity for the incentives to work because of the many changes it introduces into the programs." The possible responses were: I agree completely, I agree generally, I agree partly, and I disagree. The responses are shown below.

CHOICE	RESPONSE
I agree completely	19
I agree generally	36
I agree partly	32
I disagree	13

As can be seen, the general tenor of the responses was in support of the

hypothesis. Eighty-seven percent are on the agree side of the argument. The question is the degree and the intent of the statement in the perception of the respondents. Notice only thirteen percent disagreed. Who are the thirteen percent? Does the size or product line handled make a difference? When considered in the context of Question forty-one as presented above, the relevance of the answers becomes more significant.

Question five of Part Two read: "In many instances, the government, in administering the incentive, destroys any opportunity for the incentive to work answer on a scale from zero to nine. Zero being agree and nine being you disagree." The results are listed below.

<u>RESPONSES</u>		
	<u>VALUE</u>	<u>% RESPONSE</u>
Agree	0	17
	1	6
	2	13
	3	14
	4	8
	5	11
	6	5
	7	11
	8	5
Disagree	9	6

The distribution was more evenly spread than anticipated. Fifty percent scored a three or lower. Fifty-eight percent scored a four or lower. This defined a fairly strong feeling for support. This compared with twenty-seven

percent at the high three numbers (7,8,9,). There is a strong feeling (17%) at the zero position. There is a similar strength at the two and three levels. No such reactions are exhibited on the high end of the scale at eight or nine.

In terms of the questionnaire, it is not at all clear as to the full impact of the administrative practices on the effectiveness of incentives. There certainly is disenchantment. And a goodly number expressed dissatisfaction. In Question forty there was overwhelming support for the hypothesis. One would have thought that there would have been a similar pattern for Question five. The questions taken together seem to say that the major problems are regulatory (a catch-all), the government's inability to respond in a timely fashion, and changes to the program. Audits received less a condemnation than anticipated. The role of the government in its administration of the incentives is definitely a problem.

THE PILOT STUDY DATA

A much stronger reaction to the government administrative process was conveyed through the pilot studies. This was particularly true for the smaller companies. As written in the Phase Two report, one of the headaches was that the companies were either being audited or preparing to be audited. The process of compliance from the perspective of the contractor to administrative agencies was a daily requirement. The major problems were as follows.

1. The DCAS's preoccupation with allowable costs and appropriate rates and fee levels discouraged the company. The management never could count on a given return on its investment. There were too many factors unresolved.

2. There was never a final decision on issues. Differences once apparently resolved seemed to reappear to be reargued.
3. The government teams often threw their weight around. They were the experts. They also had the authority. And they let the company know it. (Many of their observations turned out to be valid).
4. There was a lot of redundancy. The myriad of government offices were often unaware of each others' activities.
5. Everything took longer than expected.
6. Agreements made early in the program were often reversed by a new contracting officer or auditor.
7. The inability to find a single individual who could bind the government was frustrating and confusing.
8. The significance of personal whims was at times highly destructive.
9. Enormous amounts of company time and talent was expended complying with the government's administrative offices and visiting teams.
10. The amount of documentation that was required was extremely burdensome. Was it used?
11. The many changes to the contract and the related changes in personnel coupled with the usual long performance periods obscured the original intent of the parties.
12. The threat of unallowable, unallocable and unreasonable costs hung over the head of the incentive from the beginning.

In light of the above it certainly appears that the administrative process affected the incentive in several ways. It diluted the potential of the incentive through the implied threat of reduced profit. In its

inability to respond, the government destroyed any rewards that might be earned, and by imposing its will on the producing firms, it mitigated against the motivation of the company to innovate and create. For an incentive to function as a motivator, the reward must be clearly understood, it must be reasonably attainable, and the reward must be received in a timely fashion. None of these requirements were met.

INTERVIEWS AND WORKSHOPS

There was often a great deal of emotion attached to questions of administration in the workshops. Initially there was reluctance to discuss issues that were unduly critical. This was particularly true in meetings attended by both government and industry. In sessions with the groups segregated one received a different perspective. It also made a difference if the contractor was small or large. The small contractors had less leverage. Many of the larger firms were able to ignore or thwart the less reasonable administrative burdens or requests. Not so the small companies. They were more at the mercy of the bureaucratic process.

Many of the comments made are similar to those noted above. The following represents the sentiment of the workshops and interviews. There was little question as to the validity of the hypothesis in the perception of the industry group. There was also agreement on the part of the government team on many issues that restricted the motivation of the incentive.

The industry groups almost always mentioned several factors:

1. The competitive environment resulted in buy-ins and tight targets. This destroyed any meaningful opportunity to substantially perform below target.

2. There was a tendency to think of the CPIF like a CPFF contract.
3. A company cannot reasonably predict a learning curve for five years.
4. The time periods were too long for the incentive to work. There were many reasons why this was so. For example, the turnover in personnel alone obscured the intent of the incentive.
5. The line items in the contract identified in the WBS really did not reflect how the company managed the programs. For example, how did you bill sustaining engineering? And how can you manage it?
6. Estimates to completion were grossly inaccurate.
7. The companies managed their programs on the basis of their own systems and not those of the government.
8. The companies staffed to the level of the budget. Therefore the costs were self-fulfilling.
9. If a company was to manage an incentive it had to staff accordingly. This affected overhead. Most companies were staffed to know what was going on in the incentive but not to change it.
10. There were often fixed price changes to incentive contracts. This impacted the estimated costs.
11. There was a growing tendency on the part of the government to treat CPIF contracts like FPI contracts.
12. There was no incentive to freeze the design. Changes were the key to more dollars. You could make more through changes than through cost reduction. Yet the contracts were awarded as if there were to be no changes.

13. The auditors acted as though the industry team were crooks.
14. You could never find one person to bind the government. And when you did think you had someone, it often turned out he was not authorized to do what he had done. He would say one thing and later someone else would countermand him.
15. The administrative function was preoccupied with keeping fee levels low.
16. Everything took too long. The turnaround time mitigated the potential of the incentive.

Many of the factors mentioned above were also on the government's list. However, some were unique. These follow:

1. The contractor was not to be trusted.
2. Unless audited there was a temptation to shift costs among contracts.
3. There was no real attempt to keep costs down.
4. Incentive contracts required a lot more administration than the CPFF contracts.
5. "On the CPIF there is cost certification. So let him go and we will catch him on the audit." This resulted in an attitude of punitive audits. "The whole data area is a disaster. No one really understands it. Half the data that you get nobody else can really use."
6. A major problem was the contingencies. They should be recognized from the outset and not ignored.
7. There was often more administration on a fixed price contract because of the fear of an excessive profit.

8. Competition really did not solve the market problem. We need to rethink the nature of aerospace economic markets.
9. If we did not keep our eyes on the contractors they would steal us blind.
10. Fifty percent of government procurement and contract administration was how to price. The other half was getting adequate program definition.
11. The worse thing that could happen to a government contracting officer is for an incentive to really work. If the contractor really underperformed, everyone thought that he sold the government high targets. And the negotiator looked like he goofed.
12. The average guy didn't understand incentives and how they worked.
13. The small and medium size contractors that we dealt with did not know what they were doing. They needed a lot of help in complying with the government regulations.

SUMMARY STATEMENT ON HYPOTHESIS FIVE: IN MANY INSTANCES THE GOVERNMENT IN ADMINISTERING THE INCENTIVE DESTROYS ANY OPPORTUNITY FOR THE INCENTIVE TO WORK.

There are at least two aspects to this question. One is whether the current procurement policies are consistent with the intent of the incentive. Another is whether the actions of the government administrators in implementing the policy is destructive or constructive. Are procurement policies and procedures appropriate to the effectiveness of the incentive? From the above, it appears that the answer is that much exists that is counterproductive. The literature, the questionnaires, the pilot studies, and the workshops are

consistent on several issues. These are:

1. The competitive environment might render the accomplishment of underruns highly unlikely. In that sense, the incentive is doomed from the beginning if underruns were the intended goal.
2. The intrusion of the government into the corporate process is both time consuming and costly. It might also be destructive.
3. The inability of the government to respond in a timely fashion mitigates against the effectiveness of the incentive. Rewards have to be timely.
4. Because of the close working relationship on many of the larger complex programs, it is hard, if not impossible, to identify cause and effect. If a schedule is not met, whose fault is it?
5. There is a covert attitude that industry is unethical and cannot be trusted. They need to be policed. Inherent in this attitude is a philosophical construct that the market mechanism cannot keep the companies honest. In the same vein there is an attitude on the part of industry that many of their government counterparts are not as well prepared in their jobs and/or not as motivated in its execution.
6. The administrative apparatus is an all encompassing, all imposing presence in the aerospace business. The government is always there. They are visiting or planning to do so.
7. It is not at all clear if the team (government and industry) works. Is there a mutual low key "working of the system" to get the job done? Perhaps if the facts were known, the interaction gets the

job done in spite of the prohibitive administrative burdens.

The administrative aspect of the incentive contract needs further study. To date the focus has been on other areas. Could the process be tailored in some fashion to permit the requirement of effective motivation to be met? In what ways does it help? What are the positive constructive actions that the administrative team can do to help in this regard? The administration of the contract appears to play a major role in negating the potential of the incentive.

HYPOTHESIS SIX

THE COST OF ADMINISTERING AN INCENTIVE MAY OUTWEIGH ANY SAVINGS THAT MIGHT BE ACHIEVED THROUGH THE INCENTIVE ARRANGEMENT.

How much more does it cost to administer an incentive than a CPFF? Do we spend more than we save? And how can we really measure this? If an incentive were not used and a CPFF were, where would the target costs have been set? At the outset it is important to be clear about the hypothesis. It is a crude attempt to gauge impressions about the relative costs of administration. Assume that overruns averaged fifty percent with the CPFF contracts. Assume also that incentives reduced this to twenty percent. But the cost of administration increased forty percent. Then the value of incentives would be seriously eroded. The concept would have to be carefully reconsidered.

Much of the incentive literature was silent on the question of the administrative burdens. There was very little data on specific costs. Consequently firm conclusions could not be reached. But the research was instructive as shall be seen.

THE LITERATURE

The data search, based on using incentive contracts and related terms for entry, did not reveal a single study on the cost of administering incentives. But in the studies cited in Volume Three there are hints about the problem. For example, in an Army contract guide of 1957 one of the problems cited for incentives was the additional administrative burden and its cost. (32) Also, in '58, a study at M.I.T., Air Force Major Mahoney found that one of the prime reasons that industry avoided government business was the administrative burdens. (34) Hunt took another tack. (117) He opposed

formal artificial arrangements and strongly recommended the award fee. As part of his cure he recommended active contract management. He did so to assure adequate interaction, feedback, and timely rewards. An observation by Dennis E. Mundhenk in a '74 study done at Maxwell Air Force Base is worth commenting on. He quotes a vice-president of McDonnell Douglas. "Incentives are hard to structure and hard to manage, but incentives are among the best management tools we have." (91) In a recent '81 Army Procurement Research Office study, Williams and Carr covered aspects of administration. Although not addressing cost specifically, it did comment on factors related to cost. The study cited eight possible problem areas (dis-incentives). It included lack of relationship, excessive activities, inadequate lead time, low price, excessive paperwork, delays, socio-economic factors and poor specifications. The most troublesome were excessive paperwork and undue delays. But all were ranked as being important. Particular responses varied by industry segment and size. (APRO-80-06)

In a paper prepared by Mr. James B. Gordon of TRW for a 1980 conference, similar sentiments were expressed. In talking about the general contractual environment, Mr. Gordon noted several problems relating to the cost of administration. These were increased audit surveillance, additional General Accounting Office surveys, C/SCSC, cost accounting standards, and Congressional investigations. (Remarks by James B. Gordon TRW Defense and Space Systems Group, May 1, 1980 at the Mission Assurance 80 Workshop, Los Angeles, CA).

The implications are that the costs of administration are going up. They are becoming ever more complex and burdensome. Does this increase the likelihood of meeting the procurement goals of the services? What is the impact

on proposed savings on incentives? Or in fact would the contracts work more effectively if there were more administration? Hunt suggests the key is flexible interaction. (117) This area needs further investigation. An intriguing question is what is necessary in the way of administration to make the incentive work?

THE NCMA QUESTIONNAIRE

Three questions were on the instrument to test this hypothesis. Question forty-two was: "Do you think the cost of administering incentive contracts outweighs the benefits." (Zero to nine, with nine disagree). Forty-three read: "What percent of the incentives final contract costs are attributable to the administration of the contract?" The possible responses were: less than five percent, between five and ten percent, and more than ten percent. Question five in Part Two asked directly if costs exceeded benefits.

For Question forty-two the responses were as listed below:

	<u>Value</u>	<u>% Response</u>
Agree	0	14.9
	1	3.4
	2	10.8
	3	11.4
	4	8.7
	5	10.5
	6	9.8
	7	13.5
	8	7.5
Disagree	9	8.9

About forty-nine percent answered from zero to four. And fifty-one percent from five to nine. In this respect it was about evenly split. The number feeling strongly that it did not was much larger than those who felt that it was (14.9% to 19%). For the most part the data would suggest that the specific role played by the administration of the contract probably varied with the situation. To explore this possibility additional analysis is provided below.

Question forty-three's purpose was to gain insight into the cost of administering incentives. Many rules of thumb have been around the industry for years. In the early Sixties, at the School of Systems and Logistics, the cost of contract administration was often stated to students to be about five to ten percent of the contract price. Question forty-three provided three options. The responses are listed below.

<u>Choice</u>	<u>Response</u>
Less than five percent	38
Between five and ten percent	39
More than ten percent	23

Sixty-two percent said more than five percent. Of these, thirty-nine percent said between five and ten percent. Almost one fourth (twenty-three percent) said more than ten percent. This of course has to be compared with the cost of administering any type of contract. How does this compare to the CPFF? What about the CPAF which everyone assumes is much more? What is the cost of administering the fixed price? And in computing the costs, what is to be included? It must be kept in mind that this was a broad question that attempted to get at a general assessment of the problem. The responses

must be viewed in that context. What it suggests is that the costs appear to range up to ten percent most of the time. But what does administration contribute? Would the contractors have delivered an item that worked without the government assistance? Would it have been delivered on time? What is the value received for the cost? How do these figures vary with size of company and profit?

Question six was stated as follows: "The cost of administering the incentive may outweigh any savings that might be achieved through the incentive." The responses received were as follows:

<u>Agree</u>	<u>Value</u>	<u>% Response</u>
	0	12.1
	1	4.0
	2	10.3
	3	13.4
	4	14.7
	5	8.7
	6	10.5
	7	5.1
	8	11.6
Disagree	9	7.1

The distribution was quite evenly spread. Forty-eight percent answered from zero to four. Fifty-two percent responded in the five to nine bracket. The low three numbers accounted for twenty-six percent. The top three numbered twenty-four percent. Fully one-fourth of the respondents were represented at

the strong end of each position. Perhaps the variation can be explained by the contracts handled by the firm or by the product lines and firm size. But about half the respondents' attitude was in agreement. There certainly seems to be a problem.

THE PILOT STUDIES

In the small and medium size companies, excessive amounts of the companies' administrative time was devoted to responding to the demands of the government administrative personnel. Even the CEO was involved in the smaller companies. Estimates of the time spent responding to or visiting with government administrators varied from ten to twenty percent. Another measure was the frequency of problems. For two of the companies studied in some depth the pattern was daily. Something came up every day requiring the chief executive's time relative to the administration of the contracts. It was an all pervasive phenomenon. As noted earlier the company was being visited by a government team or it was preparing for a visit. The cost of responding to these requirements was placed by the company at an excess of fifteen percent of the contract target cost.

There is little doubt that the costs of administration are often excessive. On the basis of the pilot studies one must conclude that the area of contract administration needs to be carefully reassessed. The original intent of the incentive contract to reduce government involvement in the contractors management certainly seems to have failed. Is this level of hand-holding and/or checking really necessary? Can there be some disengagement? And if there can be, where and how can it be implemented?

WORKSHOPS AND INTERVIEWS

In the workshops, it was difficult to ascertain the exact costs associated with the administration of the contracts. Such figures as the cost of data were available from contract records. However, these alone often exceeded ten percent of the contract price. But are these appropriate as administrative costs?

SUMMARY STATEMENT ON HYPOTHESIS SIX

It appears that the costs of administering contracts is excessive. This area needs careful evaluation and reassessment. The bureaucracy of the government procurement process is constantly increasing in terms of its paper requirements and in terms of increased legislative demands. What does an incentive contract need in administration over and above that of a fixed price contract or an award fee? Do CPFF contracts require more or less than incentives? The Navy and the Air Force seem to have divergent views as to the level of administration that is productive. The Navy tends to leave the contractor to run their own ship. The Air Force has concluded that they have to help run the ship. Who is right? Do we need more or less involvement in the acquisition process? At the heart of the administrative burden burns this much more fundamental question. Do we disengage or not? And if so, how much and where? It would be helpful if a meeting of all the services could be held to explore some of these different philosophies.

It probably is safe to state the following:

1. The costs of administering an incentive contract is a function of the complexity of the incentive.

2. The cost of administering an incentive contract is a function of the specific service. The Navy appears to administer less than the Air Force.
3. Much of the administrative burden is of a general nature. No matter what kind of contract one has with the government there is X amount of paperwork.
4. There is probably a minimum amount of administration if an incentive is to function properly. Hunt makes the point, and probably validly, that if an incentive is to motivate there has to be timeliness and feedback. This requires open channels of communications and interaction.
(117)
5. It is difficult to assess what the final contract performance would have been, if there were no administration (audits, etc.). Certainly there is a need for some surveillance if only against the "dishonest minority".
6. The comments most supported across the board were:
 - A. The delays in response time are very damaging.
 - B. There are probably too many audits and too much paperwork.
 - C. Too often there is mediocracy.
 - D. There is too much indecision and change.
 - E. There are too many turnovers in personnel.
 - F. There is an unfortunate pervasive lack of trust of contractors by too many government personnel.
7. Traditional incentive contracts cannot be responsive to motivational potentials unless something is done about the problems of timeliness, turnaround times, the attitudes towards rewards and the paperwork mill.

HYPOTHESIS SEVEN

MANY CONTRACTUAL ARRANGEMENTS ARE DESIGNED FOR INTENTIONAL OVERRUNS.

There are several aspects to this question. What are the real goals of the company? How are they expressed and to what extent do they dominate in the negotiation sessions? For example, companies utilize internal budgets. These reflect their best guess of real costs and have a major impact on cost outcomes. Also tight targets sometimes make the goal of significant cost reduction below target highly unlikely. In this situation do companies pay any attention to the incentive provisions on the underrun side? What impact might it have on the overrun side? Would the contractor, in recognition of his plight design the contract primarily to protect against major losses?

Large, mature contractors are risk averters and profit satisfiers. How would this be reflected in the contract incentive structure? Probably it would motivate the contractor to structure the incentive to maximize cost dollars at a given profit level. To what extent does the data support this?

THE LITERATURE

There were not many studies that dealt with this precise question. But a few addressed related issues. For example, in a paper in 1969 this author reviewed the 1968 Incentive Contracting Guide. (25) Multiple incentives were in a sense designed to permit overruns. Contractors, if they achieved the schedule and performance goals, were paid a reasonable fee (perhaps two or three percent) even if they overran one-hundred percent. During his many years of consulting the author often designed and negotiated similar incentives that permitted substantial overruns. (154)

THE NCMA QUESTIONNAIRES

Question twenty-six of Part One and Question seven of Part Two are applicable. These are reviewed below. Question thirty-nine and Question ten also bear on the issue. First, to set the issue in perspective, Question thirty-nine and Question ten are first reviewed.

In Question thirty-nine, the importance of protection as the goal of negotiation was explored. If the major purpose was to protect against an expected overrun, then the way to do it would be to structure the incentive for that purpose. From Hypothesis Four it was concluded that contractors often went into negotiation with the chief aim of protection.

In Question ten the subject of buy-ins was probed. Buy-ins turned out to be widely practiced. This again suggested probable overruns, the need for protection, and the design of contracts for anticipated overruns.

Question twenty-six read: "How often are contractual arrangements designed for intentional overruns (Part A) or as a protection against the worst possible outcomes (Part B)." The results are listed below:

A. Intentional Overruns

<u>Value</u>	<u>% Response</u>
Never	23
Always	1
Sometimes	42
Often	18

B. Worst possible outcomes (0 agree, 9 disagree)

	<u>Value</u>	<u>% Response</u>
Agree	0	7.6
	1	3.6
	2	8.4
	3	13.9
	4	8.7
	5	21.6
	6	10.8
	7	16.0
	8	6.0
Disagree	9	2.9

About a fifth of the time, one can count on the contract being designed to protect against an impending overrun. If one were to include the sometimes category one gets to sixty percent. On the other end it looks like about one-fifth of the time it is not a consideration. This tends to support the contention of contract design being primarily a protective device. Looking at the worst possible outcome protection as a dominant theme, sixty-four percent marked a five or lower.

Was the contract designed for intentional overrun? That was the heart of Question seven. The results were as follows:

	<u>Value</u>	<u>% Response</u>
Agree	0	11.0
	1	2.4
	2	8.3
	3	9.2
	4	9.0
	5	12.1
	6	3.5
	7	12.9
	8	16.3
Disagree	9	14.9

About thirty-two percent said clearly no (8 or 9). Still there were about twenty-one percent that felt that it was valid (0, 1, or 2). Forty percent answered for the 0 through 4 criteria. The answers seem inconsistent with the results of Question thirty-nine reviewed above. The resolution to the dilemma might rest in the type of contracts, the item being procured, the size of the contracts, or the firm.

THE PILOT STUDY DATA

The results varied somewhat by the size of the companies. For the small company pilot study (fifty million dollar contract) the contract was designed for protection. There was a competitive prototype development followed by a flyoff. In the early stages there were five companies, and contracts were awarded to two of the proposers. At the end of the flyoff one contract was to be awarded for production. The company bought into the prototype effort with a hope of getting even in the production phase. But then the government

decided to compete the production phase. Another buy-in was the result.

The company had no choice. It was "the only game in town". There was a lot of rationalization about getting even through changes or future buys. But the prime concern was protection when it came around to negotiation. The contract type was an FPI. The final price ceiling was the company's primary consideration. They anticipated an overrun, (if a new production method was successful, they might have been able to meet the target cost), and negotiated a high price ceiling. The government team insisted on a fixed price type contract. Yet they recognized the uncertainties that still existed in the program. Therefore a high price ceiling satisfied the needs of both parties. The contract was designed this way because the company knew it would probably overrun. The overrun was not to be intentional. It was due primarily to the tight targets.

It would be interesting to examine the price ceilings of the contracts written in the Sixties when contracts were underrunning and the Seventies when there was a trend toward overrun. The chances are that the period of overrun was also a period of high price ceilings.

For the large multi-divisional corporations, the negotiated goals were a function of the particular situation. The larger corporation had greater adaptive capabilities. For example, if there were a wide range of contracts, the mistakes on one could be absorbed by successes on others. Overruns and underruns can be averaged out. Also, there was the possibility of "gaming the numbers". There is, as one knows, a lot of flexibility in how to allocate and report costs.

Several points can be made:

1. Any cost within the cost swing presumably can occur. Are final costs within the expected cost swing really overruns? They should not be.
2. Corporations have a great deal of difficulty substantially reducing costs in the short run.
3. Motivations of corporations are complex. The particular goals of the company greatly influences cost outcomes and the design of the contract.
4. Many of the companies are not as sophisticated as perceived. Many of the incentive contracts reviewed had implications that the companies did not recognize.
5. Buying-in and contract selection and design are both parts of management strategy. Buying-in without the protection of a high ceiling or appropriate minimums was usually avoided.
6. The buy-in is really taking a contract at a higher cost than target but with a lower profit.
7. Contractors are risk averters. The upside potential is not equal to the large downside risks. In this context, the protection against potential disaster has to be paramount.
8. The wording of the hypothesis should probably have used the word expected instead of intentional.

INTERVIEWS AND WORKSHOPS

Since this question concerned contractor behavior, it was difficult to elicit remarks from the joint sessions. However, it was quite different in those sessions held only with industry or government personnel. Further, interviews with a one-on-one format were even more effective than the group meetings. Similarly, meetings held with a single company were more revealing than those involving several companies. After a while a pattern developed. It incorporated the following:

1. Most companies buy-in when it makes sense to do so.
2. When there is a buy-in there is a search for a means to reduce or limit risks.
3. A very important factor is the incentive contract arrangement.
4. A buy-in with CPFF contracts with solid minimums are ideal. They are much like a CPFF.
5. The goal is not a reasonable profit. It is protection against disaster.
6. A variety of contract structures can provide protection. Some are rather subtle. The protection is not always obvious.
7. A typical technique is a multiple with a minimum fee and healthy allotments of the fee pool to schedule and performance. The effect is to create a CPFF-like arrangement.
8. The above is often done with the knowledge of the government team. At times the government is forced to meet a standard of so many fixed price type contracts. A fixed price incentive with a ceiling at 35% is often a compromise that meets the needs of both parties.

9. Tight targets that result from best and finals may not be compatible with the incentive potential. In such an environment the interest shifts to the overrun side of the target.

SUMMARY STATEMENT ON HYPOTHESIS SEVEN

There is very little in the literature on this issue. It is perhaps not surprising. It is not the kind of question that could be easily discussed. And it raised, the company personnel were reluctant to answer it. It was not an easy area to assess in the formal research process. The questionnaires on the other hand were a little more successful than expected. From the data it was concluded that contracts are designed for anticipated overruns a good portion of the time.

The pilot studies, the workshops, and the interviews were another matter. For those companies studied, the buy-in and the use of the contract to protect on the overrun side was common practice in highly competitive situations. Another major influence was the company goals. If it happened that "investing in the future" was high on the agenda then a contract structure that permitted dollar maximization was permitted.

The following points can be made:

1. Contracts are structured to meet the goals of the company.
2. In highly competitive situations it makes sense to seek protection through the contract structure.
3. Multiple incentives can be conveniently used as protection devices by sophisticated practitioners.
4. Many of the expressed goals (see Hypotheses One and Two) such as

follow-on business, prestige, investing in research and development would encourage a cost incurrence philosophy. Contracts are structured to permit optimizing dollars.

5. Any cost within the cost envelope should not be considered an overrun. If costs end up within the cost swing the contract probably worked.
6. Stiff competition combined with flexible pricing arrangements might be sound contracting.
7. Since contractors attempt to minimize risk (downside much greater than upside) it is likely that the contract structure is utilized for that purpose.
8. Most companies buy-in when it makes sense to do so. When there is a buy-in protection becomes paramount. The contract structure is the key.

Perhaps the statement should have been "Many contractual arrangements are designed as a protection against probable overrun." In this context the hypothesis was certainly valid. The problem with the word intentional was that it implied unethical practice. To answer yes was to admit one was less than an honest businessman.

HYPOTHESIS EIGHT

MANY INCENTIVE CONTRACTS ARE INAPPROPRIATELY STRUCTURED. WHAT STARTED
OUT AS RULES OF THUMB TWENTY YEARS AGO HAVE BECOME BIBLICAL.

In traveling around the country visiting companies and conducting NCMA workshops it became apparent that many of the contracts had potential outcomes quite different than those intended by the negotiating parties. What went wrong? Was the training inadequate? Were the contracts too complex? Or did the companies intentionally "blow smoke" to keep the government off their backs? Another problem that quickly surfaced was the cookbook approach used to design the incentives. Too often examples from the guides or from prior contracts were lifted from the printed page and applied in a rote manner. Twenty years of experience has revealed that this seems to be a common occurrence. The purpose of this query was to find out just how serious the problem was.

THE LITERATURE

Between '57 and '63 the Comptroller General published eighty-two reports to the Congress on over-pricing of contracts negotiated by the three military services. And in a '59 GAO report, profits on the net worth of twenty-five aircraft and missiles aerospace firms were 71.3%. Two-thirds of those programs were on incentive contracts. (13) Congress agreed that the incentives were not working. What was wrong? How should these contracts have been structured?

The ASPR Manual for Contract Pricing published in February of '69 listed five factors that were important in the selection of the contract. These were: 1. The incentive approach, i.e., to select a contract that will motivate a contractor to control costs, (Note: Not reduce, or come in

under target, but control), 2. Uncertainties in performance (type and complexity of item, stability of design, the period of performance, and length of production run), 3. The contract environment (extra-contractual influences), 4. The accounting system of the firm, and, 5. The negotiation (negotiate contract type comes last). The incentive was to be used between the CPFF and the fixed price. This was a very good list and one that could still be used today. It was suggested that the contract should be tailored to the situation. Has it been? (14)

As an example of the biblical direction noted in the hypothesis, the '62 DOD guide drafted by Harbridge House is informative. The proposed use of the contract type was tied to the probable cost variation under the contract. It also stated that the goal was appropriate performance and schedule within controlled costs.

The recommended usages were:

1. Less than plus or minus 10% use FP.
2. More than plus or minus 25% use CPFF.
3. Between 10 and 15% use FPI.
4. From 15 to 25% use CPIF.

The document also referenced the FPIR which was a variation of the old fixed price redeterminable contract. For the most part these same ground rules are utilized today. Are they appropriate? How were they arrived at? (Seat of the pants) (18).

In the American Management Association conferences on incentives held in '63, the subject of contract design came up frequently. Several speakers commented. Professor Ralph Nash addressed the design of multiple incentives

and cited several deficiencies of design. These were: complexity, too many parameters and the difficulty of measurement. Similarly, Professor Kennedy highlighted the problems of non-linearity, the non-interdependency requirements, the problems of complexity and the inability to evaluate parameters. Mr. Lindesko of RCA talked about unattainable targets, poorly constructed performance incentives, and inadequate program definition. Gordon Tyler, then of The Goddard Space Center, reviewed the traditional contract structures and concluded that they were not suited to research and development. He talked about a new approach called the CPAF contract. (19 & 20)

In a '66 book on incentives, Kennedy, Nolan and Bass summarized the major design deficiencies. This was written after the training and the review of the contracts of some eighteen hundred Air Force personnel and some six hundred NASA personnel. The problems were:

1. The complexity. There were too many parameters,
2. The use of such techniques as PIIM,
3. The fee levels were too low,
4. The inter-dependency,
5. The inappropriate fee pool allocations,
6. The targets were too tight,
7. The wrong use of flat spots,
8. The minimum fees were too high, and
9. The technical parameters used were inappropriate.

This is still a good list of typical weaknesses, (22)

In the '67 NASA guide there was an interesting historical note on the CPAF contract. "CPAF contracting is not appropriate for any procurement

for which the firm fixed price or formula type incentives are suitable."

The guide discussed how to structure the award fee contract. (26)

Some of the rules of thumb have been lost over the years. It is not clear if the policies were intentionally changed or that the policy just got lost through lack of application. For example, in the '69 Incentive Guide, according to an analysis written in '69 for RCA, the goal of the multiple incentive contract "should be cost control and not necessarily the lowest cost." (25) Researchers who fail to take this into account can be easily misled into thinking that if the outcomes exceeded the targets the incentive had not worked. On the contrary, it had worked if the final costs were within the cost swing designed into the contract. This is not a well understood point.

The incentive guides that have been published by the DOD and NASA are rich sources on contract structuring. Several have been written. Both the drafts and the final official documents are informative. Having participated in the drafts of these proposals it is interesting to trace the intent and the application today. Usually the guides had a section or two on structure. For example, the DOD '68 draft of the then impending new '69 guide had chapters four and five devoted to exceptional methods of structuring. The guide modified the earlier emphasis on profit being the primary motivation of business; it mentioned as important motivators, company growth, prestige, follow-on business, the utilization of available skill, and the need to fill capacity.

Kenneth Gunn, an Air Force Major at the time, wrote an interesting paper on how to design incentive contracts. (28) The paper was not intended

for the expert. It was written for the person who needed a quick overview and guide. In it he listed several basic principles as he saw the problem.

The list was as follows:

1. The contract structure should be simple.
2. The mission must be clearly defined and not subject to significant change.
3. Performance parameters outside the state of the art should not be used.
4. Schedule and performance elements that are of no value to the government should not be used.
5. Do not use incentives to assure that a single element will be achieved.
6. Do not attempt to incentivize all possible performance elements.
7. Be sure the ranges of effectiveness are attainable and realistic.
8. Use cost only where there is only a minimum opportunity or need to improve performance or schedule.
9. Use the implied value technique.
10. Use life cycle "Cost systems effectiveness and critical initial operational criterion for assessing worth to the government."

These are of interest in that they highlight some of the areas of potential abuse in the structuring of incentives. (28)

Another historical aspect of incentive use and structure can be found in the '58 Air Force Guide to Contract Types. The incentive was at that time restricted in its use. It could only be used when: 1. It was determined that the use of such a contract was likely to be less costly than the other

types of contracts, and, 2. When it was improbable to secure the necessary services or supplies without the use of such a contract. The contracting officer was required by law to make such a determination. (30)

A document from '61 illustrated the divergent views on contract use. A NASA Goddard Space Center contract guide listed the following as guidance for the use of contract types:

Fixed price . . . Plus or minus 3% of target cost

Fixed price incentive . . . Plus or minus 10% of target cost

Fixed price incentive successive . . . Plus or minus 10% of target cost

Cost plus incentive fee . . . Plus or minus 15% of target cost

The award fee contract was not mentioned. (31)

Lt. Redden, in a Navy Postgraduate School study in '65, addressed the design of incentives. He highlighted several principles. These were as follows:

1. Profits had to be higher.
2. Targets had to be realistic and mutually arrived at.
3. Maintainability had to be in the performance criteria.
4. Schedule incentives had to emphasize positive rather than negative incentives.
5. Contracting policies and procedures had to be changed. (52)

Bradley and McCuiston, in a '65 paper on contractor decision making, criticized the use of wide fee swings and high share ratios. Tight target costs were also attacked as being incompatible with the incentive approach. They thought that tight targets and high shares really converted CPIF contracts into fixed price arrangements. Another problem was the attitude of

the government contracting officer. The contracting officer was reluctant to provide real motivation through adequate fee levels and appropriate share arrangements. (54)

The Booz-Allen study of '66 focused attention on several design deficiencies. It was a comprehensive study of NASA contracts. Conducted over a thirteen month period, it reviewed 62% of the then NASA contract dollar base. The study covered all aspects of incentives. The comments that pertained to this hypothesis on inappropriate design were:

1. The shares were too shallow.
2. The share ranges were inappropriate.
3. The weights among the variables were wrong.
4. The band of incentive effectiveness was too narrow.
5. The performance structures were inappropriate.
6. The effectiveness of the performance and schedule incentives bore no relationship to the amount of incentive. (56)

Cross in '66, of the Institute of Defense Analysis, in an appraisal of the effectiveness of incentives offered several observations: 1. Performance incentives did have merit but cost incentives probably did not, 2. The time periods for the performance of the incentives were too long, 3. If target costs and share ratios were raised together the efficiency of the outcomes were over-stated, and 4. If firms accepted high risk they charged for it somewhere. (59)

Professor Walter Hill, then of Syracuse University, in a '66 analysis offered his comments on the weaknesses of incentive design.

1. The size of the contract and the negotiated fee were more important than the design.

2. Firms attempted to meet performance and schedule goals even at the sacrifice of the cost target.
3. Firms traded off cost and schedule to achieve performance.
4. The government attempted to impose shares that were too shallow and targets that were too tight.
5. Multiple incentives should not have been used for research. (61)

Berhold in a '67 UCLA dissertation, through the development of a general model of contractual incentives, provided some additional insights into appropriate structure. His major points were: A. That overhead should be negotiated as a separate element with its own share, and, B. That the government should increase the share ratio until the marginal increase in the target profit is equal to the marginal decrease in the target cost. (65)

On the question of the performance and schedule incentives, Colonel Troy Jones, in a '67 Ohio State University study, concluded that performance incentives were not very effective in improving the level of weapons performance. Nor did the level of performance bear any relationship to the amount of potential fee. He found however, that schedule incentives that could be easily understood and passed on to the factory workers could be very effective. A final point on complexity was made. PIIM² and similar systems should be dropped. Simplicity was the key to effectiveness. (70)

The Logistics Management Institute in '68, in examining the foundations of incentives, made some comments on incentive structures. LMI particularly focused on performance and schedule incentives. They noted that performance incentives may have been unnecessary since the contractor was already highly motivated. And schedule incentives should have been used only when the delay

* Programmed Interdepartment Incentive Method

in work was of substantial consequence but was tolerable. (74)

Contracts became so complex in the middle and late Sixties that the Air Force set up an office to assist in their analysis. The program office for this purpose was called POESMIC. The term translated as follows:

"Program Office for the Evaluating and Structuring Multiple Incentive Contracts."

This activity was set up in '68 as part of the Space and Missiles System Office in Los Angeles. Captain William Jones, USAF, worked in that office and wrote in '70 what he had learned about the structuring of multiple incentives.

His observations from his experiences are of particular importance. They were as follows:

1. The ranges of incentive effectiveness were inappropriate.
2. The target levels of achievement were wrong.
3. The incentive formulas were too complex.
4. The multiple sharing ratios with the range of incentive effectiveness were too complex.
5. Flat spots were used in the wrong places.
6. There were too many parameters. (81)

That office has been discontinued.

John Parker of the Air Force, while at The Air Force Institute of Technology, reviewed about 2,660 contracts to ascertain whether incentive contracts worked effectively. Along the way he made several observations on contract structure. He was particularly concerned with contract cost growth. There were some surprising conclusions.

1. Contracts with high share ratios tended to overrun.

2. A negative relationship existed between contract change and contract share. The higher the share the more the changes. Incentive theory would not have expected this outcome. (It suggests that contractors with high shares seek changes to remove the risk.)
3. Contractors tended to earn performance incentives regardless of the contract cost outcomes.
4. Overruns tended to be associated with late delivery. He blamed the problem on improper contract structuring. (82)

Professor Hunt (117) in his work has offered some principles on contract construction. In his '71 study with Rubin and Perry, he offered the following ideas:

1. Use simpler contracts.
2. Avoid contracts making specific motivational assumptions.
3. Generally discourage the use of automatic incentive contracts.
4. Make contractual arrangements flexible.
5. Write the contract to focus on the problems of the procurement and not on the contract itself.
6. The contract should not be structured about some immutable, specific, universal set of assumptions about either the nature of the performer or the context of the performance.
7. The contract should be mainly reward based, be immediate, unambiguously contingent on performance, equitable, and dispensed within a feedback system that makes clear the exact relationship between the rewards and the actions of the performer.

8. The contract should be structured to leave the tactical problems of intra-organizational subsystems and personnel motivation to the managers of the respective organizations.

Dixon in '73 also was critical of the basic assumptions that underlie contract structure. There was statistically a significant relationship between the share rate and the negotiated profit rate. No such statistically significant relationship existed between the sharing rate and contract cost outcomes. And variations in cost overruns and underruns, costs of supplemental changes and contract cost growth were unrelated to the value of the sharing arrangement. (89)

Mundhenk, in '74, focused on specific contracts in an attempt to learn how a contract for a weapon system should be structured. He studied the C-5A, the F-15 and the A-10. In his search he also studied contracts from 1953 to 1973. His major conclusion on structure was that each major contract had to be tailored to the situation. The C-5A was an example of the plane being fitted to the method instead of the other way around. The F-15 was presented as an incentive that was appropriately structured. It utilized milestones, prototyping, and total package procurement. An important clause, he thought, was a quantity adjustment clause that permitted automatic correction for changes in quantity. (91)

In a study of cost growth effects on share ratio and range of incentive effectiveness conducted in '74, Robert Launer of The Army Logistics Management Center uncovered a number of interesting relationships:

1. There seemed to be a built cost overrun base of 20% on CPIC contracts.

2. There was a positive correlation between share ratios (on the underrun side) and contractual adjustments.
3. On the other hand, overruns and contract adjustment were statistically independent, and,
4. Of particular note, the amount of underrun or overrun was usually less than the range of incentive effectiveness.

Launer suggested that the incentive range and contract changes were critical factors. (92)

DeMong in '78 wrote a summary article on the meaning of the research on incentives. In the article, he summarized the points of view which he synthesized from the literature. Among the issues that he looked at were several that related to appropriate contract structure.

1. Hunt had found schedule incentives to be superfluous. However, Parker and Belden found a positive correlation between schedule delays and overruns. Belden found that schedule incentives tended to be lost rather than earned. LMI also questioned their use but concluded that they could be used to convey information.
2. On performance incentives, Hunt thought they were probably redundant. Belden and Parker came to about the same conclusion. They were earned whether there was an underrun or overrun. And Ehnert and Kaiser in a study of civil engineering contracts found that they added little. (99)

Another interesting study was that of Gaver and Zimmerman of the University of Rochester, done in '76. They analyzed the Air Force data base of the DD350, DD1499, and DD1500's. They offered a list of observations

on contract structure. A few follow:

1. On contracts with broken share lines the profit rate varied inversely with the share rate.
2. The higher the share rate the less likely a cost overrun would occur.
3. The magnitude of the overrun/underrun varied inversely with the share rate.
4. The frequency of the adjustment of the share line was inversely related to the share rate.
5. The probability of a cost overrun varied with the length of time required to perform the contract. (104)

There have been a number of theoretical approaches to the design of incentives. These have provided additional insight into contract structure. For example, Schick and Pace in '79 concluded that the major problem was that the variables were not independent. The models that did provide for interdependency like PIIM and Gemini were too complex. The authors suggested a simpler model. (134) In the same context, Ostrofsky and Triner in '71 applied probability distributions to the design of multiple incentives. They related the several parameters to a single incentive scale. This would result in a single output and only one incentive regard. (135) Another example was the work of Paul Pirdle. He did not think multiple incentives worked. He structured the performance incentives directly to the customers' cost variations. The scale of the incentive was directly related to the degree of variation of the like cycle cost as a function of performance. (137)

The '73 Aerospace Industries Association study is of unique interest. It represented the combined views of a segment of the industry. The study reviewed the proposed incentive contracting guide of DOD and NASA. Twenty-six companies participated. Some of the comments are reproduced below.

1. The cost and schedule incentives appeared reasonable, but the performance incentives were not. They were always subjected to measurement problems.
2. The contracts were overly complicated.
3. The multiple incentive should not have been used for research and development.
4. The emphasis should have been on reward.
5. The government applied incentives in order to reply to directives. They did not use adequate thought as to how they should have been applied.
6. The government often failed to motivate the contractor.
7. When incentives were unilaterally established by the buyer in a competitive environment, the targets did not represent realistic and attainable goals. Then the incentive contract features were largely meaningless.
8. There was a tendency for the buyers to establish the targets as near the ceilings as possible and to set performance goals so that there were penalties rather than possible rewards.
9. It was considered that schedule incentives were utilized as liquidated damages in another form. Multiple incentives tended to be fragily structured at best and impossible to administer.

10. The incentive contract structure did not reflect the real world situation.

THE NCMA QUESTIONNAIRE

Question 27 from Part One, and Question 8 from Part Two are applicable. Question 27 read, "The rules of thumb generally in use for the design of incentive contracts are: Not valid, Sometimes valid, Rarely valid, and Always valid." The results of Question twenty seven are presented below. Attention is then given to Question eight.

The data:	<u>Choice</u>	<u>% Response</u>
	Not Valid	.02
	Sometimes Valid	84.00
	Rarely Valid	11.00
	Never Valid	4.8

From the above it can be seen that about fifteen percent of the time regulatory framework of rules of thumb are not appropriate. But fully eighty-four percent of the time they are sometimes valid. In retrospect the structure of this question should probably been different. What is necessary is the significance of the term 'sometimes valid'. To gain further insight into this problem, Question eight is addressed. Question eight read: "Many incentive contracts are inappropriately structured. What started out as rules of thumb 20 years ago have become Biblical." With zero agree and nine disagree the following was reported.

	<u>Choice</u>	<u>% Response</u>
Agree	0	25
	1	8
	2	15
	3	16
	4	7
	5	9
	6	3
	7	6
	8	6
Disagree	9	5

One fourth answered at the zero level. Sixty-four percent answered from zero to three. Seventy-one percent answered from zero to four. Eighty-one percent were below five. This was a very strong endorsement for the hypothesis. It seems to suggest that many of the current rules of thumb have to be either re-thought or applied more flexibly.

Part of the problem with this question was that it assumed some level of competency on the part of the respondents on the appropriate application of theory to developing incentives. To test this competency several questions were introduced in the questionnaire to see if the individual answering was acquainted with some fundamentals of design. Question sixteen was one such question. It addressed the size of the fee pool for multiple incentives. Multiple contracts need larger fee pools than straight cost if CPFF type cost

arrangements are to be avoided. The responses were:

<u>Choice</u>	<u>% Response</u>
Do require a larger fee pool	70
Do not require a larger fee pool	30

The correct response is "do require". About thirty percent of the people answering did not seem to understand this. This raises some serious questions on the level of competence of some of the people negotiating these contracts. Summarizing on the questionnaire data the hypothesis certainly appears to have validity.

THE PILOT STUDY DATA

The smaller contractors visited did not comprehend the full ramifications of the incentive contract. Usually the only person in the company who understood them at all was the one or two persons in the contracts group. Often these were men hired away from one of the larger aerospace firms or from the government. To the extent that these men were competent, then the contracts were reasonable for the circumstances. At least they reflected the goals of the contractor. As noted in the write-up for the case studies, the companies were often confronted with a buy-in. The need of the contract was to protect against a major overrun. The goal was risk aversion. A high price ceiling solved the problem. The fee was determined by the traditional profits of the FPI contract. The slopes were within the prescribed ranges. It was not a very creative structure. It provided the contractor with almost no incentive to underrun. The targets were too tight due to the best and finals. In terms of the negotiations the determining factors in the contract

structure were the biblical rules from the guides as developed over the years.

For the larger firms, many of the contracts also seemed to be inappropriately structured. In some cases it was the intent of the company to create flexibility through complexity. In others, it was simply a case of implementing traditional rules without due consideration for the particular situation. There was always a temptation to pull an example from some reference and apply it.

There seems to be a need for education at the bottom rung on the fundamentals. Much of the training done in the Sixties and early Seventies seemed to have been lost due to the turnover in personnel. Specifically, there was not sufficient tailoring to the probable motivational drives of the contractor and the realities of the procurement. The patterns did not reflect the very high probability of overrun and the almost non-existent probability of underrun. Traditional target profits were almost always applied. Fee pools were too limited to offset the advantages of incurring costs. This area is pursued farther in Hypothesis Nine, Ten, and Eleven.

INTERVIEWS AND WORKSHOPS

The incentive structure was a popular subject. It was the focus of many of the discussion groups, and there were usually a wide range of problems cited. Many were similar to that alluded to in the literature and the pilot studies. There was a common agreement on a number of important elements. The most important factors are cited below:

1. The range of fees available for the targets are well known by both parties. Traditional ranges exist for the various type contracts.

2. Contract structures that are imposed by the government regardless of the company situation are not productive.
3. Multiple incentive arrangements are usually such that neither party really can predict the outcomes of future events.
4. Too often the intent of the multiple incentive is to create "log".
5. The slopes of incentives tend to be selected based on past practice rather than the particular situation.
6. The cost incentives are often not achievable.
7. Incentives on schedule and technical performance might not be productive in a highly competitive procurement. Contractors have already offered their best in order to secure the program.
8. Too often schedule and performance incentives are set by the government at levels that are impossible to substantially improve. Again there is the problem of the highly competitive situation.
9. The maximums on profits takes a lot of the potential out of the incentive.
10. Some incentives are so complex that neither party really knows what they have negotiated.
11. Fixed price arrangements in a cost type environment forces the contractor to seek protection from excessive risks. The resulting contracts are often not reflective of the appropriate fixed price incentive methodology.

12. The incentives negotiated are too often not tailored to the information systems of the contractors.
13. The potential for awards is not consistent with the potential for losses. The downside risk often exceeds the upside possibilities.

SUMMARY STATEMENT ON HYPOTHESIS EIGHT

The literature, the NCMA questionnaires, the pilot studies, and the workshops and interviews all lend weight to the probability of improper contract structure. Are incentive contracts being tailored to the situation? Or are the book examples being plucked from the pages for indiscriminate application?

When the subject of structure is used several factors are usually considered. These include the target cost, the target profit, the slope, the range of incentive effectiveness, the size of the fee pool, the allocation of the fee pool to cost, schedule and performance, and the specific elements in the schedule and performance incentive arrangements. The incentive guides and the training manuals have provided over the years examples of how these should be combined for particular procurements. The intent was to provide the contractor with an incentive to meet the goals of the government in the most efficient manner possible. Presumably if a contractor had an opportunity to increase his profits by delivering early, or by performing at a particular technical level, or by achieving the above at some reduced cost, he would do so. The key often was the structure of the incentive.

The picture from the review is discouraging as to the assumptions. First and foremost, extra-contractual factors often play a much greater role in contractor behavior than the contract type. Secondly, it appears that the upper limit on profit makes it economically more attractive to incur costs than to reduce them. Further, the competitive environment places the contractor in such a high cost position relative to target that all potential for significant cost reductions are lost. That is the macro picture. As to the micro aspect on actual contract design elements, the following is offered:

1. The fee ranges are too narrow.
2. The cost swings are too narrow and unrealistic. They are inconsistent with the real world.
3. The downside or risks exceeds the upside potential for gain.
4. There does not seem to be a relationship between slopes and outcomes. Does this mean the slopes are too shallow?
5. Complex incentives are difficult to negotiate and impossible to administer. The greater the competition the less meaningful the underrun side of the contract becomes.
6. Many of the personnel charged with negotiation of the incentives really do not understand them adequately.
7. Rules of thumb are indeed biblical. Ranges of fees and slopes are used without any appreciation of the implications.
8. The fee pools are allocated without due consideration on the cost slope. This problem was observed time and again.
9. There are too many elements incentivized.

10. It is often not clear how rewards are to be earned or when they should be paid.
11. There is often not a clear line between the goals of the buyer and the incentive structure.
12. The CPIF contract when the fee pool is allocated to the schedule and performance elements closely resembles the cost aspects of the CPFF contract.

This area needs immediate attention.

HYPOTHESIS NINEPENALTIES ARE BETTER MOTIVATORS THAN REWARDS

In the context of severe competition and the related best and finals, the incentive potential is often lost before the game begins. The competition forces the contractor to buy-in or at best come in with a target so tight that he has little or no chance of an underrun. What he seeks is protection on the overrun side of the target cost. What would happen if he were confronted with stiffer penalties on the overrun side? If there is little probability of an underrun, should not the emphasis be on assuring that he does not overrun? These are the kinds of inquiries that initiated the interest in this hypothesis. As will be seen the literature and the practice of the use of penalties has varied. For the most part, they have been discouraged since they appear to be inconsistent with the general idea of positive motivation.

THE LITERATURE

Liquidated damages was a standard penalty in the late Fifties and early Sixties. Another penalty was termination for default. As protection against intentional overrun, DOD recommended the use of unlimited cost sharing or the use of sizable negative fees. (27) Similarly, NASA in its early '67 guide recognized high negative fees and unlimited cost sharing but discouraged their use. Thus, both DOD and NASA had provisions for the use of negative fees of one kind or another. The question of negatives comes into play for all aspects of the multiple incentive; schedule, performance and cost elements can all have a negative aspect. (24) In balance, the penalty provisions were generally discouraged in favor of the positive aspects of rewards. They were defined, however, for appropriate situations such as buy-ins.

The Electronics Systems Division in '62 held a briefing on procurement problems and methods in which they commented on the use of negative fees and penalties. As a possible cure for overruns they suggested the use of penalty provisions for incentives. To quote: "To us the standard ASPR cost incentive provision is slanted too much toward increasing the fee for cost reduction and not enough toward penalizing the contractor for incurring an overrun in costs". As an example of the effort to extend rewards rather than penalties, the ASPR committee wrote a letter to AIA in '63 (Colonel W. Thybony). It covered the ASPR's committee's role in broadening the protection against termination. It also discussed the new shared savings clause for value engineering. Among other requests they asked Congress to consider multi-year funding. (11)

The Monterey, California AFSC Conference Manual of '63 highlighted the discussions of the prior years efforts. Included was the summary on the proposed changes in contracting policies to meet Secretary McNamara's initiatives. The emphasis was to be on positive incentives. Penalties were to be downplayed. (12) Karl Vinson had not been convinced. He had argued long and ardently against the use of the reward provisions. He had felt strongly that there was a need for strong penalties. In fact, he had led the fight for the Renegotiation Act of '51 and the Truth in Negotiation Act. (13)

In February of '69, The Department of Defense published its Armed Services Procurement Manual #1 (Armed Services Procurement Regulation Manual for Contract Pricing). The manual cited a rewards and penalties policy. "Policy should and does emphasize the positive aspects of the incentive approach . . . however, the negative aspect might be just as strong in influencing contractor's decisions." (14)

Going back to the original guide of '62, the emphasis was on the positive. But negative incentives were recognized. A problem, however, was the ceiling on profits. At that time the limit was fifteen percent on cost type contracts.

In an American Management Conference in '63 attended by aerospace and government personnel, Mr. Lindesko of RCA summarized many of the industry's concerns with the use of incentives. One of them was "the punitive attitude of the contracting personnel". (19) Also for a good discussion of the vacillating attitudes toward the use of punitive measures, see Kennedy, Nolan, and Bass's Incentive Contracting in the Aerospace Industry. (22) In the early Sixties, penalties were discouraged. The middle and late Sixties saw their revival by the Air Force. The Seventies witnessed a reversal to the positive aspect.

Appendix A of the NASA '67 Cost Plus Award Fee Contracting Guide has an excellent discussion on the theory of positive and negative stimuli in motivating behavior. It said the fear of failure and the hope for success were both motivators. The particular effectiveness varied with the individual and situation. The predominant thrust of the CPAF was positive. Thus, the contract contained the carrot but not the stick. Positive and negative effects of the incentive contract should differ for different organizational structures. It should be a function of how closely knit the organization is. It should vary by individuals and be based on their achievement levels and expectations. The impact of the negative and positive incentives was also dependent on the situations and the motive strengths. Positive effects might be related to the desire to seek pleasure. Negative or penalty effects might be similar to frustration produced behavior when goals were not attainable. Thus, the

outputs for awards may be far more beneficial than that of the negative penalties. (24)

The original '62 Guide recognized that minimum and negative fees were being used but doubted their usefulness. "It is doubtful since high maximum fees are not feasible that a contractor would accept a negative fee." Downward only incentives were however recognized. (18)

From the literature on the effectiveness of incentives, there were several references on the use of penalties. Redden, on the premise that positive motivators were not adequate, suggested the increased use of penalties. He felt that the rewards were not large enough and the penalties were not great enough to protect against poor performance. Further, he felt that schedule incentives should have stressed penalty rather than reward factors. (52)

Bradley and McCuiston commented briefly on a factor that is germane to the penalty question. Contracting officers have had little inducement to negotiate steep shares. They felt that there was little potential for negotiating steep shares. They felt that there was little potential for negotiating fee arrangements which would stimulate contractor efficiency. (54) Cross struck a similar tune. Cost incentives were probably not effective. Short run efficiencies were not practical. (59) Hill in a '66 study for the Navy, was also critical of the contracting officers' reluctance to negotiate steep shares (penalties and rewards). Since contractors attempted to assure satisfactory profits at the negotiation table and there was a tendency to shift costs, penalties might be appropriate. (61) Air Force Colonel Troy Jones in an Ohio State University doctoral dissertation, in

studying the early Sixties' use of incentives concluded that they were not effective in curtailing cost growth. (70)

The '69 draft of the DOD Guide recommended schedule penalty only incentives. It discussed the advantages and disadvantages of penalties. "Generally it is true that performance rewards only and schedule penalty only appear to be the most appropriate". But they recognized that a penalty only would probably be objectionable to the contractor. (27)

Another interesting study was that of Captain William Jones who worked for POESMIC analyzing and structuring incentives. He wrote an article about his experiences. He summarized the major weaknesses of incentive contract design. The problem of negatives was prominent in its' absence. Apparently it was not a major issue in his work. (81) Hunt, in his '71 work on the conceptual foundations of the award fee contract, speaks to the stimulus-response patterns assumed in incentive contracts. He provided a psychologist's insight to the advantages and disadvantages of penalties as opposed to rewards. It is a common issue and a popular one in the discipline. For the award fee contract, he recommended that it be primarily reward as opposed to penalty based. (85) Dixon, in a '73 paper, struck at the heart of the issue when he concluded that there was no statistical evidence to support the use of positive incentives to reduce costs and improve performance. (89) Roberts and Short in an early Sixties study, observed that the greatest motivator of the contractor was his desire to avoid large losses. They thought that the potential for loss far exceeded that of gain. (141)

Williams and Carr, in a Darcom sponsored study in '81, also addressed the effectiveness of penalties as traditionally used. They reported that performance bonds and the possibility of default were not effective. The study also evaluated dis-incentives. Those reported as significant by industry were excessive paperwork, preoccupation with low price and undue delays in solving problems. Others mentioned but less significant, were lack of continuity and socioeconomic contract requirements. Poor specifications were the least troublesome. The government respondents listed paperwork, delays in solving problems, inadequate lead times, and the inability to compete with incumbents as the major dis-incentives. The lack of a continuous relationship was noted by both groups. (Contract Motivation, Theory and Application, Army Procurement Research Office, Fort Lee, March, '81 APRO-80-06.)

What does the literature tell us? The incentive contract era started in recognition that liquidated damages and other punitive approaches as then applied were not working. The attempt was to harness the positive aspects of motivation. The hope was that the carrot was better than the stick. That was 1961. Since that time, as reflected in the guides and in practice the DOD and NASA have flirted off and on with the thought of negative fees and a variety of other penalty provisions on incentives. Penalty only on cost, schedule, or performance have been sparingly used. The use of penalties usually arose under circumstances where the positive features are probably going to be inoperable or ineffective. Such situations are caused by a variety of extra-contractual circumstances. Buying-in is one possible cause. Another is low capacity. A third is severe technical deficiencies. The question is when are penalties useful and to be recommended?

THE NCMA QUESTIONNAIRE

Questions fourteen and fifteen from Part One and Question nine of Part Two asked about the use of penalty only incentives. Question fourteen pertained to multiple incentives; Question fifteen applied to schedule incentives. These are discussed below.

Question fourteen read: "Multiple incentive contracts . . . should or . . . should not include penalty only incentives." Eighty-five percent said they should not. Fifteen percent said they should. Obviously the large percentage of the respondents voted no to the use of penalty only incentives. A similar pattern arose on Question fifteen. The question read: "Schedule incentives . . . should or . . . should not include penalty only incentives." Eighty-four percent said no. These answers illustrate the rather unanimous feeling against penalty only provisions expressed by industry.

Question nine of Part Two of the questionnaire read: "Penalties are better motivators than rewards." The respondent was asked to give his opinion on a range from zero to nine, with zero being agree and nine being disagree. The results as are shown below strongly favor the disagree end of the scale.

	<u>Choice</u>	<u>% Response</u>
Agree	0	11
	1	2
	2	6
	3	7
	4	6
	5	8
	6	7
	7	2
	8	13
Disagree	9	30

Fifty-one percent answered with an eight or nine. Thirteen percent answered with a zero or one. About one-fourth answered in the zero to four range. Data was also gathered on air frame, electronics, propulsion and munitions. The figures are as follows:

<u>Value</u>	<u>% Response</u>			
	<u>Air Frame</u>	<u>Electronics</u>	<u>Propulsion</u>	<u>Munitions</u>
0	13.9	10.8	9	2
1	7.4	1.7	2	3
2	5.5	6.1	4.5	6
3	3.7	6.7	4.5	3
4	2.8	5.1	9.1	5
5	5.6	5.1	6.2	12
6	3.9	5.1	3.3	5
7	3.7	1.4	4.5	3
8	19.3	12.5	18.7	18
9	35.2	45.5	38.2	42

The strength of the attitudes are clearly portrayed. Some are stronger than others, but nobody wants penalty only. Questions eight and ten also addressed the issue.

Question ten addressed the buy-in. The data revealed that it was widely practiced. If the buy-in is a viable strategy, this helps explain the attitude toward penalties. One would expect an industry response to be unfavorable to a penalty incentive. A buy-in with stiff penalties for overruns would be difficult to accept. From the governments' perspective, the penalty might be the only protection against an obvious overrun situation.

In Question eight, the nature of the overrun was examined. Which element is slipped first? Is it cost, schedule or performance? The answer was cost. Schedule is slipped second. Again if the situation is a buy-in what can be expected? A similar input was obtained on Question seven and nine which inquired on goals of negotiation. What has emerged is a picture that describes firms as risk adverse. What are the implications for contract structure? Should it be positive rewards or negative? Should it be the carrot or the stick?

THE PILOT STUDY DATA

To quote from the pilot study, "The basic concern of the company was the price ceiling. The company did not want to lose money. It wanted to optimize development goals within the dollars available. The company optimized dollars not profit. In that sense the penalty of the incentive price ceiling was much more effective than the opportunity to earn more profit dollars through cost reduction. That opportunity had been lost much earlier in the program."

Much of the traditional literature in psychology opts for positive rather than negative stimuli. The positive rewards are presumably more influential in modifying behavior. Penalties even run the risk of encouraging the very behavior one wants to eliminate. But in spite of the common wisdom, it might make sense under the competitive pressures of typical weapons procurements to use penalties to prevent undesirable behavior. The rewards available through incentives seem to be inadequate to offset the advantages of cost incurrence.

To summarize, the pattern that emerged in the pilot studies was one of contractors who were attempting to minimize risks after very competitive procurements. Often, the opportunity to reduce costs below the target had long been lost. The question was simply how far did one expect to exceed the target? How big was the overrun likely to be? In this environment the incentive was negotiated to provide protection on the overrun side. If extra-contractual factors warranted, there was always a temptation toward substantial overruns. The amount was a variable of the particular situation. Often this was recognized by both parties and reflected in the negotiated contract with the full knowledge of all.

Across the board, the most meaningful element in the contract to the firm's management was the potential disaster points. The penalties had more visibility than the rewards. The managers all knew the price ceilings or the penalties for schedule delays. In this context, the penalties acted as constraint elements. Once the potential for cost reduction, schedule and/or performance incentives were lost, the attention focused on the protection against ruin.

INTERVIEWS AND WORKSHOPS

Industry is very strong in their position against penalty type incentives. There is even a stronger feeling against penalty only provisions. Conversely, the attitude toward penalty incentives by government personnel was positive. They felt that there was a role for the penalty type incentives. One particular application was worth noting. A type of contract popular on the west coast was an incentive that started out with a fee of fifteen percent

and could only go down. In this perspective, it was a penalty only. But the difference was that the contractor started with the maximum fee. Although aggregate data was not provided on its effectiveness, the group using the contract said it was successful.

SUMMARY STATEMENT ON HYPOTHESIS NINE

The literature from psychology is filled with the debate on this issue. Which is better, the carrot or the stick? The answer depends on what you want to do, when you want it done, and what you hope the future behavior to be. For the most part positive motivators are better than negative with individuals. What about with corporations? To the extent that the accomplishments reflect on the individuals and the rewards go to the individuals, positive rewards are most beneficial.

The questionnaires and interviews showed the strong negative sentiment of industry often associated with penalty type motivators. Certainly, when added to the already burdensome aspects of best and finals in the competitive mode, they could well tip the scale to disaster. Since contractors tend to be risk averse, they certainly do not welcome penalty (or penalty only) incentives. And experiences over the last twenty years seem to bear them out. The DOD and NASA guides discourage their use. Negative fees and unlimited cost sharing are reserved to those situations where an intentional massive overrun is likely. What then is the conclusion? It is this. Penalty type provisions are probably most effective in getting management's attention. And where overruns are likely, they are probably necessary. The major points are:

1. If the incentive is structured correctly, then the contractor can and probably will be motivated to reduce and/or control costs.
2. If there is no opportunity for cost reduction then penalties might have a place.
3. Schedule penalty only incentives are really like liquidated damages.
4. If liquidated damages and termination for default did not work in the Fifties and Sixties then why should penalty clauses work now?
5. The intent of the incentive contract is to harness the profit motive. It is to provide a positive incentive for cost control. Penalties only are inconsistent with this philosophy.
6. Penalties are related to the risks of the contract. The fixed price contract that has the highest incentive also carries the greatest penalties.
7. Penalties are probably most appropriate for cost type contracts.

HYPOTHESIS TENTHE MORE COMPLEX THE ARRANGEMENT OF THE INCENTIVETHE MORE LIKELY IT WILL BE IGNORED.

Complex systems such as PIIM* and MICAP* were a trend of the Sixties. Complexities might also become a hallmark of the Eighties because of the award fee contracts. The range and number of the elements and the relationship among the variables determines complexity. PIIM, for example, was a multi-dimensional mathematical model. An often heard corollary to complexity was KISS. KISS translated means keep-it-simple-stupid. It was a crude but effective way of conveying the need for simplicity in incentives. But how simple? For example, if one were to use only one cost, one delivery and one performance factor you would still have three variables. Are they dependent or independent? In practice, it was not unusual to have twenty or thirty variables. There might be cost, six or eight milestones for schedule and eight or ten performance factors. Multiple incentives are by nature rather complex. They require skill in development and management time in administering. Have they worked?

There are several aspects of the inquiry. Should multiple incentives be abandoned? There seems to be a drift by the users in that direction. One or two major commands have informally outlawed them. If they are used how should the parameters be related? Should penalty be utilized without rewards? And what about performance and schedule parameters? Are not adequate incentives already provided to meet the specification and time demands?

- * Programmed Interdependent Incentive Method--PIIM
- ** Multiple Incentive Contract Analyzer Procedure

THE LITERATURE

This question has already been reviewed under Hypothesis Five, Six, Eight and Nine. No attempt will be made here to again summarize all of it. But a flavor, a representative sample is appropriate.

Historically multiple incentives started out relatively uncomplicated. (18, 19) But complexity soon became the rule rather than the exception. PLM and other computer assisted techniques became in vogue. By the late Sixties, twenty, thirty, or more variables were not uncommon in the performance and/or schedule area. Computer assisted analytical tools were developed to aid in their analysis. But disenchantment seemed to have set in by the late Seventies. But the appropriate use of the multiple incentive is still a vital unanswered question.

Going back in time, Gordon Tyler, Director of Procurement of The Goddard Space Center at an AMA conference in New York, reported on the experience at Goddard. He suggested that the traditional multiple incentives were not well suited to research and development. He therefore was experimenting with CPAF contracts. In that same conference, Gordon Arthur, the then Air Force Chief of Pricing raised the issue of whether companies really made tradeoffs. (20) Walter Hill, of Syracuse University raised a similar issue in a '66 study. He found that multiple incentives probably were inappropriate for research and development. Contractors did not generally engage in tradeoff behavior to optimize short run profit. Mathematically precise, complex techniques were inappropriate. He also stated that the training in multiple incentives was incentives. (61)

On the same track, an in-house NASA study by Root-Allen in 1966, concluded there was no evidence of tradeoff. (56) Colonel Troy Jones found much the same: "There was no evidence of tradeoffs. Complex systems were ineffective and hard to administer; PIMM should be discouraged." On the other hand, schedule incentives, in Jones' view, could be effective because they could be clear and could be managed. (70) A Rand study by Fisher (76) added fuel of the same kind. Complex arrangements were highly questionable, he stated. LMI in '68 concluded the same. (74)

Captain William K. Jones in 1970 agreed. Arrangements were too complex, and the incentive formulas were too complicated. (81) Parker, although only addressing the complexity issue indirectly, noted that contractors tended to emphasize performance outcomes regardless of the arrangement. (82) Much of Raymond Hunt's work concluded by sounding sour notes on traditional incentives. Included in his criticisms were comments similar to those already noted. The term he utilized a lot was mechanistic. Contracts should be flexible and be managerially, rather than contractually oriented. (85, 117) M.W. Dixon in '73 found that no correlation existed between shares and outcomes. This attacked the very foundation of the multiple incentive concept. (89) Hill and Shepard in '73 found that there was no evidence of tradeoffs and that motivational programs were not evident in companies. (90)

Oppendahl's study on contractor motivation rang a similar bell: contractors do not have systems to make tradeoffs among cost, schedule and performance factors in complex multiple incentives. (95) Donald C. Barker (114) in '74 raised a similar concern. He concluded that the amount of the fee

pool did not determine contractor motivation. Since incentive contracts generally were not effective, multiple incentives had no sound theoretical basis. Again Hunt, Rubin and Perry in '77 found, that for fully two-thirds of their sample, no special administrative techniques were employed for incentive contracts. (117) Paul Pirdle in '75 chorused the familiar ring. There was no evidence that cost or performance incentives had improved contractor performance. (137) Schick and Pace in '70 offered a clue to the problem. They stated that multiple incentive contracts did not work because the variables were not interdependent and that they were too complex. They offered an alternate approach (134) and a Chemical Weekly Magazine article agreed. (64)

What can we learn from the above? Several ideas dominate. Complex incentives, perhaps more than simple cost incentives, do not seem to be implemented by industry. They do not improve performance or reduce cost. They might aid in maintaining schedule. They do not work because of the various motivations of the contractor. They do not work because of the administration required to make them work. Whether the complex multiple incentive achieves the goals of the contractor is another matter. Perhaps they help provide enough smoke that the contractor can achieve more flexibility in the management of the contract. Also, perhaps the structure reduces overall risk.

The NCMA Questionnaires

There were several questions that pertained to complexity. These were Questions thirteen, fourteen and thirty-six from Part One and Question ten from Part Two. Each of these are discussed below.

Question thirteen read: "Multiple incentive contracts are . . . more effective than simple cost incentives . . . are less effective . . . makes no difference." The results were:

More effective	41%
Less effective	37%
Makes no difference	22%

The results suggest that attitudes toward the multiple as compared to the simple cost incentive are mixed. About a fifth of the respondents said that it made no difference. The balance was about divided; about forty percent thought the multiple was more effective than the simple cost incentive.

There are several possible explanations. Researchers have routinely found that the benefits of incentives include better program definition, a clearer understanding of the requirements, and better communications on the program. Perhaps these are associated with the multiple incentive. The multiple incentive also provides flexibility and reduces risk. It can, if cleverly designed, provide the same protection as a CPFF. And the procurement situation makes a difference. But the "bottom line" from the respondents is that there is a large segment of contractors who feel multiple incentives are probably more effective than simple cost arrangements.

The recent DARCOM study by Williams and Carr revealed similar sentiments. Industry according to that study thought the key was proper use and sound

pricing arrangements. (APRO-80-06) But what should be its appropriate use? Question fourteen sheds some light. Question fourteen read: "Multiple incentive contracts:

- A. Should or should not use penalty incentives,
- B. Should or should not be as simple as possible,
- C. Should or should not incentivize all major goals."

This question was designed to test several aspects of incentive design. The answers for Part B were:

Should	95%
Should not	5%

There was overwhelming support for simplicity. This was the case for all classes of the respondents.

Question thirty-six again looked at simplicity. It read: "The simpler the incentive, the greater the probability of achieving the contractual goals. Your choice on a scale from zero to nine." The results were:

	<u>Value</u>	<u>% Response</u>
Disagree	0	1.0
	1	.5
	2	2.0
	3	2.7
	4	.9
	5	6.8
	6	11.5
	7	23.5
	8	23.6
Agree	9	27.5

About seventy-five percent responded with a seven, eight or nine. About ninety-two percent scored a five or greater. The simpler the better is a widely held attitude. Two and a half percent (from zero to three) felt complexity was the key. Under what conditions would complexity be advantageous? One situation would be when you wanted to obscure the activities of the company. Another aspect is how simple is simple? Can it be so simple that the incentive is meaningless?

Question ten from Part Two also addressed the hypothesis. Whereas Question fourteen spoke of simplicity, Question ten phrased the question in terms of complexity. It read: "The more complex the arrangement for the incentive the more likely it will be ignored. Again on a scale from zero to nine give your choice." The results were:

	<u>Value</u>	<u>% Response</u>
Agree	0	30
	1	11
	2	15
	3	10
	4	7
	5	4
	6	4
	7	7
	8	5
Disagree	9	7

Again there was wide support for simplicity. Fifty-six percent had a two or lower. About three-fourths had a four or lower. On the other hand, about one-fifth of the group did not feel that complex incentives would be

ignored. Why? Again as suggested by the '73 AIA and '81 DARCOM studies a segment of industry feels that multiple incentives have a use and a place in the weapons procurement business. They might help in program definition. The process of structuring the incentive could clarify the goals of the parties. And they might assist in risk aversion. Perhaps it is the opinion of some companies that complex technical programs naturally require more complex incentives. However, those favoring complexity are a minority. For most, simplicity was the recommended way of contractual life.

Summarizing on Hypothesis Ten, the questions supported the fundamental idea of simplicity. This was consistent with the literature and with common sense. If administration is a problem to begin with it can only get worse with added complexities. A clear program as defined by basic schedules and technical goals helps both parties. It is a question of judgment as to how many of the major parameters of the program to include. On the basis of the data, the emphasis should be on simplicity.

THE PILOT STUDIES

Even simple incentives are often ignored. In the pilot study of the small firm, the contract used was a simple fixed price incentive. However, the contract type was not the most important factor in the contractor's decisions. Extra-contractual factors dominated the behavior of the firm. There was very little attention paid to the incentive except for the price ceiling. The company bought into the program after a stiff competitive procurement. There was no opportunity for the company to significantly reduce costs. The best it could hope for was to minimize losses. It hoped to make money on the follow-on. To further complicate the situation, nobody in the company other than the contract negotiator really knew what the incentive was

all about. Further, there was no real in-house administrative mechanism to manage the program.

The company was a high tech organization. It placed great emphasis on the achievement of its technical goals. A performance incentive was not necessary to motivate the contractor to achieve its technical goals. If the contract had been a multiple incentive, it is doubtful if the company would have done anything differently. This was more a function of the company and its structure than the contract type. The company simply was not in a position to manage a complex incentive.

For the larger prime contractors visited the story was much the same. There was not a single incident of an in-depth attempt to manage the organization through the elements of the incentive. The contract was negotiated and then it was treated pretty much like any other contract. This varied somewhat with the size and relative impact of the contract on the company's sales and future.

Given the difficulty with simple incentives, it should be no surprise that the complex incentives proved almost impossible to administer and implement. As an aside, in one of the contracts reviewed, the intent of the contractor was to assure management flexibility by obscuring his actions through a complex arrangement. Its intent was to maximize confusion and to minimize risk. This was not uncommon. Right across the industry the feedback was the same. Complex incentives are difficult to structure, difficult to administer or manage and for the most part, do not work any better than more simple ones.

Complicated incentives have another aspect. Sometimes the contracting parties were not fully aware of what they had negotiated. Neither party realized where the structure drove the contractor until well into the program.

In three specific incidents studied, the incentive structure had to be dropped or changed when the contracting parties realized where it was leading. The general consensus was that complex multiple incentives are not workable and not worth the effort. For the most part, they had been abandoned by the companies and the government offices visited.

INTERVIEWS AND WORKSHOPS

The visits across the country reinforced the comments above. There was and is a general disenchantment with complex multiple incentives. This was true for both sides: The government seemed to be as dissatisfied a customer as industry. A major segment of one of the services has unofficially discontinued their use. The same feeling was expressed by another agency. In conversations with a host of aerospace companies there was not a single supporting vote for the use of complex multiple incentives.

SUMMARY STATEMENT ON HYPOTHESIS TEN

If an incentive is to work it must be simple. All the evidence from the literature suggests that many companies did not implement even the simplest of incentives. What happens to the complex ones? Not much. The literature reinforced this observation. The major studies all commented on the need to avoid unnecessary complexities. There were too many parameters. The relationship among parameters must remain straightforward. As Hunt (117) has said so well, clarity and simplicity are the keys to effective incentives.

The questionnaire and workshops provided additional support. The four questions, particularly viewed as a group, say simplicity, simplicity, simplicity. Perhaps incentives are not implemented because of their complexity. Certainly, if the customer is dissatisfied enough to ignore them, there is something wrong. As was seen, there was great dissatisfaction with the multiple incentive.

The culprit might be the unattainable goals established. Therefore, the game becomes "to cover one's backside." In the competitive environment of best and finals, this assessment might be coming pretty close to the real world. The major findings appear to be as follows:

1. They were difficult to construct.
2. The typical contracting officer did not fully comprehend them.
Rules of thumb dominated.
3. They were difficult to manage. This was particularly true in a highly competitive environment.
4. The companies apparently had not found it worth their while to set up infrastructures to implement the incentives.
5. The major attraction of the complex incentive to a company seemed to be that it either had a give-away aspect that the government did not comprehend or that it minimized risk through a low cost share line, and
6. The administrative burdens escalated with the complexities of the incentives.
7. Everyone seemed familiar with the concept of KISS. The byword is to keep it simple. That's the common wisdom.

HYPOTHESIS ELEVEN

THE MOST IMPORTANT ELEMENT IN THE INCENTIVE IS PERFORMANCE.

CONTRACTORS WILL READILY SLIP COST AND SCHEDULE GOALS TO MEET PERFORMANCE GOALS.

A central concern raised over the years has been whether performance parameters should be included in incentive structure. If contractors were going to meet the specifications anyway, why pay them extra to do so? So goes the oft heard remark. This aspect has been a focal point of controversy among incentive theoreticians. Given the option, companies would presumably readily slip cost or schedule to meet performance. They do so because performance is the key to future business and profits. But just how important is the performance aspect? The literature is rich on opinions. The NCMA questionnaire had six questions dedicated to this query. As shall be seen the data is consistent. There are some legitimate concerns on the use of incentive performance elements.

THE LITERATURE

In the first incentive guide, the use of incentive contracts were related to the problems encountered with the CPFF contract. Between 1951 and 1961 its use had tripled. It had gone from thirteen percent to almost forty percent. In that time frame, certain questions had been raised about the quality of DOD products. Horror stories were rampant. Schedules lagged, costs soared and products failed to perform. Thus, in '62 DOD moved to stimulate industry performance. And it gave industry the opportunity to make extra profits through superior performance. That was the original intent

of the incentive contract. At that time the usage of CFFP contracts were targeted to be reduced to their '51 level. The DOD felt so strongly about the use of incentives that it stated that "to the extent possible, firms not willing to negotiate incentives may be excluded from consideration for the award of development contracts." As a matter of policy, performance incentives and schedule incentives could be used only when appropriate cost control incentives were applied simultaneously. In the example of structuring the incentive, performance was assigned fifty percent of the fee pool. Further, "perhaps no other DOD procurement policy offers greater potential rewards than the expanded use of performance incentives in development contracts." Also, "properly applied these performance incentives can do more than any other single factor to encourage maximum technological progress under a single contractual effort." (DOD, Incentive Contracting Guide, Harbridge House, 1962, p. 30). The goal was to complete a satisfactory item at a reasonable cost. Such was the framework of the performance incentive. (18)

Performance incentives were not new. A 1907 contract for a heavier than air flying machine had a target of thirty-six miles per hour. The bidder had to submit costs for various performance levels. (6) A form of performance incentive was also used in World War II. But the real push for their use as currently defined came in '61. (22) At first there was reluctance to use performance incentives. In a '63 American Management Association meeting in New York, Mr. Lindesko of RCA, in summarizing the industry experience to date, noted the refusal of industry and sometimes government to write performance incentives. This was particularly true of the Army, who was reluctant to use incentives at all. (19, 32)

Of historical interest, the '58 Air Force Guide to Contract Type traced the increased use of the cost type contract to the increased complexity and nature of the end items. Cost contracts had grown substantially in the Fifties. (30)

In the Sixties, studies proliferated on whether incentives were working. Redden, in a study done for the Naval Post Graduate School, concluded that performance incentives needed to include maintainability provisions. (52) Bradley and McCuiston, in a study for NASA in '65, found that there was little potential for negotiating fee arrangements which would stimulate contractor efficiency. The authors felt that the performance could better be controlled through some method of contractor performance evaluation (award fee?). (54)

Booz -Allen studied incentives for NASA in '66. Included in a rather massive study were some observations on the performance incentive. They found that contracts were being written without the use of interim milestones to which they objected. And they found that there was no relationship between the dollar value of the incentive and effectiveness of the schedule and performance incentives. (56) Cross, in '66 while at the Institute for Defense Analysis, in appraising the effectiveness of cost incentives, found merit in performance incentives. He found that they provided the contractor with additional flexibility and thereby tended to reduce his risk. (59) Still in '66, Professor Hill of Syracuse in talking about "observation on incentive contracts", thought that firms would normally place great emphasis on attaining schedule and performance goals in order to enhance reputation.

Firms would normally trade off cost and schedule for performance. He hypothesized that contractor behavior was determined by a host of extra-contractual factors. Many of these were linked to performance. (61)

Colonel Troy Jones of the Air Force, in a doctoral dissertation at Ohio State, raised serious doubts about whether performance incentives worked. He concluded that performance incentives were not effective in improving the level of weapons performance. He did find, however, that performance incentives did provide some motivation above and beyond the fee potential. But he found that the effectiveness of the performance incentive "appears to bear little relationship to the amount of the additional profit available by their attainment." And more seriously, when performance incentives were used "cost overruns were much greater since the contractor traded off profits from cost overruns to surpass performance goals." He felt that performance incentives should be used only with FPI contracts. (70)

The Logistics Management Institute in '68 completed a study on incentives for OSD. In it they reviewed six earlier studies. On performance incentives they concluded:

1. Performance incentives may be unnecessary.
2. The potential to use incentives for tradeoffs is highly overrated.
3. They recommended the discontinuance of performance incentives in development contracts. (74)

When so many studies were critical of the effectiveness of the incentive, Jones and Pierre in '69 were laudatory. They felt that they worked. The distribution of outcomes was shaped in favor of underruns. Although inflated targets were a possibility they found that the significant amount of the

underrun could be attributed to the incentive. Presumably that meant that the performance incentive also worked. (79)

William K. Jones of the Air Force, while assigned to POESMIC, analyzed the deficiencies of multiple incentives. He found that the values of the goals were often misunderstood (value statement). He also noted that there was too much complexity in the performance elements, and that there were too many parameters. (81) In '71, another Air Force Captain, John Parker used linear regression and empirical analysis to study Army, Navy and Air Force incentive contracts. He concluded that contractors tended to earn performance incentives regardless of the contract cost outcomes. He emphasized that cost, schedule and performance parameters were not independent. (82) Again in '71, Hunt with Rubin and Perry were generally critical of the traditional incentive contracts. They also had some particular comments on performance incentives. They recommended (partial list):

1. Seek simplicity.
2. Encourage use of simpler contracts
3. Generally discourage the use of automatic arrangements, and
4. Apply incentives only to cost.

Hunt wanted to link motivation to performance through a vehicle like the CPAF contract. (85)

Assuming that the traditional performance incentive did not work, what would? Runkle and Schmidt, two Captains at the Air Force Institute of Technology, wanted to find out. In a '75 study of government-contractor interaction, they focused on the award fee type contract. They concluded that there was no relationship between the amount of the award fee and the

level of contractor performance. They found that the key to effective motivation was interaction of the top level management. (108)

In '75 Major Fiddle of the Air Force, studied the problem of structuring contractual performance incentives. He concluded that "there was no evidence that incentivization for either cost or performance had provided significantly improved contract outcomes." He recommended an alternate approach. (137)

This was similar to a '66 study by Fleming and Moore where they introduced a system called P-R-I-C-E and assumed that the problem with multiple and performance incentives was the inability to convey to the contractor the value of the government's goals. (141)

In a '76 study of the utilization of performance incentives on production contracts, Knepshield stated that the studies to date had suggested that incentives on production contracts should be cost only. He disagreed. He concluded that there should be incentives on quality and reliability. (165)

In summarizing the literature, it must be concluded that much of the research to date has been skeptical of the effectiveness of performance incentives. They did not seem to improve overall performance. Contractors were driven to achieve performance anyway. On the positive side it might:

1. Add something over and above the fee motivation.
2. Help in clarifying the goals of the contracting parties.
3. Improve program management.
4. Facilitate and improve organizational communication.

THE NCMA QUESTIONNAIRE

Six questions from the NCMA questionnaire were applicable. These were Questions eight, fourteen, fifteen, sixteen, and thirty-one from Part One and Question eleven from Part Two. They approached the problem from different points of view.

Question eight was designed to evaluate the contractor's behavior when he confronted an overrun. What would be the priority of his corporate goals? Are schedule, cost or performance goals slipped first? The second part of the question asked the same thing in a slightly different fashion. If there was an overrun which was held onto the longest? The results supported the common wisdom.

<u>Choice</u>	<u>% Response</u>
Slipped First:	
Schedule	58
Cost	37
Performance	5
Held Longest:	
Schedule	10.5
Cost	18.0
Performance	71.5

Contractors slip schedule, then cost, then performance. What can this convey about the proper design of incentives? How does this impact on the distribution of the fee pool? It is this. Slopes and cost constraints should be applied consistent with the probability of overrun. Therefore, the

slopes for schedule should reflect the fact that it is typically slipped first. A similar approach should be taken with cost and performance.

Question fourteen, Part C asked whether multiple incentive contracts should include all major goals. It went directly to the heart of complexity and the importance of performance incentives. The responses were:

<u>Choice</u>	<u>% Response</u>
Should	57
Should not	43

No clear pattern emerged. Part of the problem could be in the interpretation of the words "all major goals." About half the group opted for including all major goals. That usually leads to complexity. But how many are "all major goals"? This is explored below.

Question thirty-one read: "The multiple incentive fee pool share devoted to performance parameters should be: 10% . . . 20% . . . 30% . . . 40% . . . 50% or more to be effective." The results were:

<u>Choice</u>	<u>% Respondents</u>
10%	6
20%	26
30%	30
40%	17
50%	21

It is of interest that almost all the respondents felt that the fee pool allocated to performance had to be greater than twenty percent. Fully thirty-eight percent felt it should be greater than forty percent. This suggests that unless a significant proportion of the fee pool is devoted to

the performance element, it would not be an effective motivator. This is inconsistent with the observations in the literature that performance goals are met regardless of the fee pool allocated. Another difficulty is that if a large part of the fee pool is allocated to the performance area, the cost slope ends up to be shallow (dependent variable). Perhaps the responses reflect the relative importance of the performance element. That is, the performance element is the most important. This would be consistent with the hypothesis.

Question eleven of Part Two read: "The most important element of the incentive is the performance element. Contractors will readily slip cost and schedule goals to meet the performance goals. Score a zero to a nine. Zero is agree and nine is disagree." The results were:

	<u>Choice</u>	<u>% Response</u>
Agree	0	16.0
	1	9.0
	2	9.0
	3	13.5
	4	9.7
	5	6.6
	6	7.0
	7	9.7
	8	9.5
Disagree	9	11.0

In Question eight there was strong support for the hypothesis. When asked which would be slipped first among cost, schedule and performance the reply was cost. Cost was slipped first, then schedule and then performance.

In question thirty-one there was a definite support for large fee pools. Question sixteen was also of interest on this point. It asked whether multiple incentive contracts needed larger fee pools to work. About seventy percent felt strongly that the effectiveness of a multiple depended on a large fee allocation.

Part Two had a direct question. Would the contractor readily slip cost and schedule to meet performance goals? The responses were mixed. There were as many agreeing as disagreeing. It would be hard to support this hypothesis on the basis of Question eleven. The answers to eight and eleven seem to contradict themselves. In Question eight, if there was to be an overrun the performance aspects dominated. But when the question was asked if a contractor would readily slip cost and schedule to optimize performance the results were quite different. Perhaps the problem with Question eleven was the subtle allegation of dishonesty.

What can be stated from the above? Perhaps the following is safe:

1. Performance is the most important aspect of the incentive.
2. To work they need large fee pools.
3. The important goals, but as few as possible should be incentivized.
4. When confronted with possible overruns contractors slip first cost, then schedule and lastly, performance.

THE PILOT STUDY DATA

The hypothesis was supported by the pilot studies. As noted, the researchers into the nature of incentives have questioned the necessity of performance incentives. Are not the contractors professionally motivated to achieve performance goals? Do not the specifications define the required standards for performance? It is a valid question. The contractors studied

were motivated on their own to produce a superior technical product. The basis for the future business was often technical competence and reputation. The requirement of the performance goals did, however, introduce a discipline for clear definition and an understanding of exactly what the government requirements were. Also, the need to define the parameters and the criteria for measurement forced the parties to think the program through. The process required to negotiate acceptable technical performance incentives did have beneficial side effects on program definition.

INTERVIEWS AND WORKSHOPS

In every workshop this question was asked. Are performance incentives appropriate? Do they work? Then a second question was asked. If overruns are imminent, which of the parameters is slipped first? Which is slipped last? On these particular issues there was a common ground. Performance goals were often the dominating goals of aerospace companies. Their future was often linked to technical supremacy. Also there was a technical fallout to commercial sectors that made technical investments make sense. If the contractual arrangement permitted, they would spend all the dollars they could for technical achievement.

SUMMARY REMARKS ON HYPOTHESIS ELEVEN

The literature seriously questions the success of the performance incentive in improving the effectiveness of performance. The bulk of the researchers concluded that the companies were motivated to achieve performance goals even without the added motivation of the incentive contract. There were, however, other benefits. Communication on the technical requirements often improved. Generally, program definition was better. Internally in the organization,

There was more discussion and analysis of the project and the technical parameters were carefully considered by the managers who were to be held accountable for their accomplishment.

On the government side, the program managers were more aware of the progress of the program and better informed on technical progress. The parameters provided a basis for measurement and review. It also encouraged government-industry interface. It fostered a team effort. In those areas where the government had expert technical staffs, they were able to advise and assist the contractor's technical personnel. In this fashion, it facilitated communication.

As to the nature of the trade-offs in the contract itself, there were several common problems noted. Too many parameters were used. The selection of the parameters was not consistent with desired outcomes. The relationship among the variables were too complex. The variables were often interdependent and not recognized as such. The allocation of the fee pool was arbitrary and inadequate to foster motivation. The slope on the cost portion as a result of the performance incentive was often too shallow. Summarizing:

1. Contractors tend to slip performance last.
2. The second variable slipped is schedule.
3. Performance is viewed as the most important aspect.
4. The amount of the fee pool allocated to performance must be substantial.
5. When the primary motivation of the contractor is follow-on business or technical achievement then the performance incentive may be unnecessary.

The hypothesis appears valid.

HYPOTHESIS TWELVEINCENTIVES HAVE TO HAVE ORGANIZATIONAL VISIBILITY TO WORK.

The original conception of incentive contracts was that, "the firm would harness the profit motive to produce more effective weapons at a lower cost in a better time frame." An integral part of the assumption was that the contractors would organizationally implement the incentive arrangements. It was assumed that the companies would delegate the parameters within the organization. Thereby, the variables of the incentive arrangement would become an integral part of the budgets and of the related planning and control documents of the company. The incentive arrangement and philosophy would help weld a team to work efficiently in order to maximize short-run profit. (18, 22) Do members of the firm know about and understand the company's incentive contracts? Are the elements passed down to the factory floor? And to what extent is it necessary to do so? The two key questions are:

1. Do incentive contracts need organizational visibility to work?
2. Are companies implementing the incentives organizationally?

THE LITERATURE

The original '62 DOD guide outlined the presumptions about industry's organizational adjustments to properly implement the incentive contract.

These were:

1. Incentives were not to require any new management techniques.
2. They would require more sensitivity to management control techniques.
3. The firms would have to pay the same attention to incentives as to fixed price contracts.

4. The accounting systems would have to detect impending problems soon enough to make corrections.
5. The reporting system would have to relate cost, schedule and performance elements in sufficient detail to permit tradeoffs.
6. There would have to be closer coordination and communication among engineering, financial and contracting personnel. If the incentive contracts were successful, "it might be possible to reduce government control substantially. Also much of the post-award guidance given by the government would be unnecessary."
7. The contractors' requests for approval, interpretation or direction would have to be given promptly.

The guide said some contradictory things. On one hand, it indicated that firms had to do nothing organizationally new. They were to treat the incentive like a fixed price contract. On the other hand, the guide stipulated the need for inter-organizational cooperation and communication concerning the contract. And information systems had to be in place to assist in providing the data for its management.

In the bonus-for-savings contracts used in World War I, the contractor had to be able to identify specific actions that led to the cost savings to be paid. Presumably, under such conditions the contractor had to keep accurate records of his actions and their relationship to performance outputs. (22)

Another insight as to the government's assumptions of the level of inter-organizational involvement between the contractor and the government can be grasped from the NASA '67 guide on award fee contracts. To quote, "the structure of the contract, including the criteria, weighting, and sharing

fee emphasis communicates the government's objectives and priorities to every supervisory level in the contractor's organization." (24)

In an early '62 study by J. Marymore, of The National Association of Professional Contract Administrators gave some insight into the problems of managing contracts within the industrial organization. The purpose of the study was to describe the task of the contract administrator in industry. Five hundred and twenty defense contractors participated. Typically the contracts personnel were swamped by a large number of contracts. He "was overworked and understaffed." Given these circumstances, he had little time to devote to any one contract. Often he was not able to get really involved in any particular effort. This study was made a long time ago. Has it changed? (36)

Lt. Redden studied the use of incentives in the aircraft industry while a student at the Naval Postgraduate School. Among his conclusions was an observation on organization visibility. He noted that "the farther down the organization the incentives are applied, the more effective they are likely to be." On a related topic, he felt that government's controls over the contractors operations should be kept to a minimum. (52)

In a '66 study by Lkoz -Allen on NASA contracts, it was concluded that there was no evidence of tradeoff activities. Further, the effectiveness did not seem to be related to the amount of fee that could be earned. Rather, it was a matter of the clarity and objectivity of the structure. They found that there was inadequate feedback to management. And specifically, they found that the contractors did not communicate details of the incentives to the working level personnel. (They noted an exception with the performance factors.) (56)

John Cross in a '66 paper provided some food for thought. He said cost reduction has to be institutionalized over a long time period. It has to be done through new devices introduced into the existing routines. In the short-run, opportunities for cost control were too nebulous. He said that contractors did not organize to implement short-run profit because to have done so would have been fruitless. (59)

Colonel Troy Jones concluded similarly in a '67 Ohio State University Ph.D. dissertation on incentives. In a comprehensive study of the '63-'64 time period, he found no indication that contractors had ever attempted to make precise tradeoffs. But on the positive side he found that incentives had exerted some motivation on the contractor to improve his organizational structure. Jones said that if there was organizational delegation it sure did not show up in his study. He also found that the incentives did not work. (70)

IMI, in an OSD sponsored study in '68, took another look at the foundations of incentives. In a short paper they reviewed six prior studies done by Booz-Allen, the Defense Science Board, Dr. Cherington, Professor Walter Hill, Colonel Troy Jones and Professor Scherer. The studies agreed on several points that are applicable:

1. Incentive structures can clearly communicate the government's objectives to the contractor.
2. They can attract the attention of management.
3. They can provide a useful motivational tool.

But they concluded that for most of the contract life, the contractor is not in a position to make tradeoffs. Also the potential to use incentives for tradeoffs is highly overrated. IMI seemed to say that for incentives to

work they had to be clear and be tied to individuals. That is, they needed organizational visibility. (74)

Professor Raymond Hunt of Buffalo University has done as much and probably more on organizational interaction and incentives than anyone else. It is hardly fair or feasible to extract a few lines from his work. And it is difficult to accurately portray his findings in a brief space. But fundamentally he was opposed to the traditional fixed formula incentives such as the CPIF and the FPI. He strongly supported the use of flexible incentives with a high level of communication among the contracting parties. In a '77 paper with Rubin and Perry, he found that there was no special incentive contract administrative techniques employed by the companies he studied. Fully two-thirds made no adjustments. Also, there was little or no awareness of incentives presumed below the first line supervision. It was unusual to strive to extend awareness to the operating level. (117)

In another study in '78 by Hunt, Near and Rubin, Hunt gave a rather sobering portrayal of how firms formulated their goals. "In motivation and performance, perceptions are not simply an expression of the perceiver's viewpoint: instead they reflect the literal everyday life of the organization. And these indicate that life is rather disjointed. Goals of the organization and its subsystems, as well as perceptions of environmental constraints, appear to be only weakly related to conceptions about what factors influence project performance." He suggested that the organizational absorption of the incentive goals was highly unlikely even if desirable. (119)

Williams and Carr, in an Army Procurement Research Office study of contractor motivation published in March of '81, shed some light on the problem. Although they did not take up the problem of the importance of how companies internalize and manage incentives they did address related issues.

The more salient points were:

1. There was a natural adversarial relationship. The parties did not trust each other.
2. The goals of the government did not match those of the contractor.
3. Incentives worked if properly structured and priced.
4. The contract was not the only factor in influencing behavior. Extra-contractual factors dominated the concerns of the contractors.
5. They quoted Huat's idea that motivation is a long term process transcending any one contract.
6. The government gave out conflicting signals on goals. While ostensibly talking price and schedule the real message was performance. Different offices of the buyer played different roles. Not all had the same goals. For example, the user command might want performance, while the buyer talked price.
7. The attention a particular contract got was a function of its' importance to the organization.

Williams and Carr seemed to have said that the organizational institutionalization of a particular contract is unlikely. But they concluded that mutual interests and matched goals are essential to proper motivation.

(APRO 80-06)

In the draft of the 1969 guide the language about profit being the primary motivator was scratched. Also it emphasized that the purpose was to emphasize simplicity. Contracts had become too complex. The contract had become an object in itself without due awareness of the end items being procured. "In the past, the contractor has often failed to organize any system for assuring that the government's desires are understood by his organization." This was a conclusion drawn after the review of thousands of incentive transactions. (Comments On Incentive Contracting Guide, by D.N. Pitts, July 19, '68 in a letter to Mr. Jack Livingston. Also see draft of DOD and NASA Incentive Contracting Guide, Jan. '67.)

Industry might not set up an infrastructure to implement incentives because they are perceived as impossible to achieve. Much of the literature suggested this possibility. For example, the AIA study of incentives of March of '73 suggested just that. With the era of increased competition, its best and finals, tighter schedules and high technology performance goals, the targets might be unachievable. (Results of COSIDA Survey concerning DOD/NASA Incentive Contracting Guide. October '69 AIA, Wash., D.C., 1973)

Summarizing on the rather sparse literature one would have to conclude that:

1. Companies do not delegate or implement organizationally the incentives.
2. Perhaps this was because it was not worth it. How can you change an entire organization for one or two contracts?
3. Perhaps the contractors felt that the incentives were not achievable.

So they set up to minimize risk. (See Hypothesis Seven)

4. The goals of the parties differed. Different segments of the buyer's organization probably gave out different signals. Consequently, the contractor was forced into covert gaming to satisfy the various constituencies.

For a more direct assessment of the issue the NCMA questionnaires are considered below.

THE NCMA QUESTIONNAIRES

Three questions were used to assess this hypothesis. Question thirty-seven asks if in fact this is valid. Are the elements of the multiple incentive passed along? Question thirty-eight asked the same in a different manner. It asked whether anything was done to implement it organizationally. And Question twelve in Part Two asked if an incentive contract had to be passed along organizationally to work.

Question thirty-seven read: "Contractors implement the features of incentive contracts by using the target rewards and penalties within the organization and by allocating them to appropriate organizational components." The respondent was asked to give his assessment on a scale of zero to nine. Zero was not at all and nine was very well. The results were as shown:

	<u>Value</u>	<u>% Response</u>
Not at all	0	12.0
	1	7.5
	2	10.1
	3	11.0
	4	12.0
	5	13.0
	6	10.5
	7	13.5
Very well	8	7.4
	9	3.0

Very few agreed with the statement. Only ten percent answered at the eight or nine level. Eighteen percent answered at the zero or one level. However, when comparing the top and bottom three values it is not as striking. The figures were about thirty for the zero to two values and twenty-three for the seven, eight and nine values. The middle range averaged about twelve and was consistent. There was a slight bias toward the not at all position. One would have to conclude on the basis of question thirty-seven, that some industry segments seemed to be delegating at least the major parameters to the major functional areas. But a lot of companies also appear to be doing very little.

Question thirty-eight asked that if parameters were passed along, to what extent would they achieve organizational penetration? The question read: "After negotiating the incentive contract, the company does very little to make the incentive work. Give a response from zero to nine. Zero is never and nine is always." The results were:

	<u>Value</u>	<u>% Response</u>
Never true	0	8
	1	7
	2	13
	3	16
	4	8
	5	10
	6	8
	7	15
	8	9
Always true	9	6

About forty-four percent of the respondents answered at the three or lower position. Apparently firms do something. The question is what? A similar statement could be made about the firms that do delegate. About thirty-eight percent answered with a six or higher. The strength at the extremes was equal. Fifteen percent said always, fifteen percent said never. At the first two levels the distribution was about evenly split. It was not a strong endorsement for concerted positive action. One would have to conclude that there was more implementation by the companies answering the questionnaire than one would have projected from the literature. This is particularly surprising. As the interview data will attest, not a single example was found of substantial delegation of the incentives past the first line of management. Executives below the first two tiers did not have any idea of the details of the incentives. One or two examples came to one's attention but none were observed at first hand. A couple of possibilities suggest themselves. Companies might not want to share with outsiders how they actually manage incentives. Or again, the people answering the questionnaire might not have been in a position in the organization to really know. Or perhaps companies are doing a lot more than was expected.

Question twelve of Part Two again asked: "Incentives have to have organizational visibility to work. Score a zero to nine." Zero was agree and nine was disagree. The results show that there was strong agreement on this point.

	<u>Value</u>	<u>% Response</u>
Agree	0	39
	1	13
	2	16
	3	9
	4	2
	5	5
	6	2
	7	4
	8	4
Disagree	9	6

Visibility was important. Nearly fifty-two percent answered at the zero and one level. At the other end of the scale only ten percent answered at the eight or nine level. About four-fifths answered at the four or lower level. The responses strongly favored the hypothesis. Incentives have to have organizational visibility to work.

What insight is provided by the questionnaire? Question thirty-seven suggested that incentives are delegated in some fashion some of the time. There were obviously times when it was not delegated at all. And there were occasions when it was moderately pursued. Certainly it was not broadly applied nor substantively implemented. There were enough not-at-all answers on the scale below five to cause alarm as to the exact extent of delegation. Apparently some takes place. But where and how? Question thirty-eight dug deeper on the same issue. Do organizations really allocate the penalties and rewards to the appropriate organizational components? Almost half of the

respondents were on the never side of the question. The strength on the agree scale was weak. Again, some delegation apparently is taking place but it is probably limited in scope and used on particularly important contracts. Yet when question twelve on organizational visibility was asked, there was general agreement. Visibility is important. Are these conclusions compatible with the literature? Not quite. The literature pretty much concluded that multiple incentives are not delegated or used in any formal organizational way. But it is apparent that some delegation does take place. The question should be how much is done? As to visibility, both the literature and the questionnaire agree. It is vital to the success of the incentive. Again, the question must be raised, what kind and how much visibility is required? Additional insight was gathered in the pilot studies, the interviews and workshops.

THE PILOT STUDIES

For the small companies there was no structure set up by the company to manage the incentive; these were treated like every other contract. Part of the problem was that the contracts department was often just one or two men. And they often had only superficial knowledge of incentives. In one firm, the head of estimating was a former government employee. He had a good grasp of the theory. But since he and the contracts director did not get along, he was not brought into the loop of communication. Since he knew more than the contracts individual he was avoided. The contracts man wanted to remain the expert. He did not want to be threatened by somebody from estimating who knew more about his job than he did.

There was also another problem. The company had adopted a matrix type organization at the insistence of the customer. That too added to the confusion. There were eleven programs in all; six of the eleven were considered major. Of these, there were two CPFF, two CPIF, one FPI, and one FP contract. The financial manager did not have any previous experience in government contracts. Yet he was responsible for gathering cost data and providing reports to the top management. Even though there were weekly and sometimes morning staff meetings among the key functional and administrative personnel, the incentive features were not managed. What received attention was the total price. How much have we spent and how much do we have left? Can we meet the commitments? The awards had been on a competitive basis. And for three of the largest programs the company had bought-in on the prototype phase. They hoped to recover on future phases of the program. Though the organization costs always seemed to exceed the estimates. Why? The company had many grueling sessions of self recrimination. To an outsider the problems seemed to stem from the company's situation of rapid growth, their general lack of experience with the development products, their optimism (often associated with dynamic successful growth companies), and the fierce competitive atmosphere. In short, uncertainty and change were the culprits.

Almost without exception, the company had promised to meet questionable technical and schedule goals. In fact, they really did not know how they were to achieve the technical targets. They did, however, have a concept. The engineers knew generally how to go about it. They knew the right direction. But as any experienced engineer will attest, "Murphy worked overtime." If things can go wrong they would. And they did. The result was constant

concern and anxiety about the technical parameters. Will it work? Can we meet first article? Can we win the competitive flyoff? Can we come in under the price ceiling? "Work those value engineering proposals and engineering changes." They had to get healthy. In short, the incentive never had a chance for significant cost reduction. The incentive had visibility at the top, but lower down, the engineers and the production personnel did not even know the significance of the contract types. After a while in the meetings, they mouthed the words but they did not understand the implications. They worked their own budgets and schedules but the budgets and the elements of the incentives never matched. By the time the contract was finally negotiated, the targets had already been exceeded due to the work already going on in-house. It is doubtful even if there had been an organizational entity, that the outcome would have been any different. Events outside the contract were the determining variables. Certainly, the company could have been more aware of the incentive contract's status, and they could have had an information system to provide timely and descriptive feedback. But external and internal technical and economic factors would still have dominated in the decision process.

The visits to the large organizations merely reinforced the above. The dynamic nature of the change (confusion) influenced everything. But it was to a lesser degree than for the smaller, less sophisticated companies. The firms usually had adequate, if flawed, information systems that tracked costs by work breakdown structure. The technical parameters were known to the engineering staffs and program directors. The program manager was familiar with the contract and its structure. He had helped negotiate it. In this context, the contract had visibility across the functional departments. But the

visibility was horizontal.

Given the concept of centralized management, it could be argued that this was all that would or should have been required. A few people at the top could have run the show. Everybody did not need to know the details of the incentive. All they had to do was meet their budgets for time or technical milestones. It is not an argument that can be easily dismissed. How much visibility is really necessary? Companies have their own agenda for goal accomplishments. Individuals have their own. Can the government, an outside organization, change these for whatever reason? There was not one single example for a formal vertical implementation of the incentives, reported to or observed during the pilot study phase of the project. On the basis of the pilot studies, one has to conclude that very little organizational visibility existed. This was disconcerting since industry seemed to view visibility as critical to the success of incentives.

INTERVIEWS AND WORKSHOPS

After several months it became obvious that either the examples of incentive contract delegation did not exist or that the companies were unwilling to display them. In every workshop and in every NCMA talk, a request was made for information concerning same. On many occasions, there were often over fifteen contractors in the discussion groups representing the cream of the crop of aerospace companies. The group was asked if they had actually worked the incentive. Did they delegate the aspects of the incentive horizontally and vertically? Did it become an integral part of the management planning and control system? There was general agreement that only a partial, if any, organizational change was made to implement the parameters. An organization was already in place to create, develop and build. A reward system for the

employees was an integral part of the organization. It really was not practical to impose a second. Companies had a large number of programs. They could not set up a different system for each. If the program was large enough and important enough to the company then it was considered. If it made sense it was implemented. If it did not make sense then some adaptation was made as appropriate. To an outsider, the incentive did not have visibility in the sense of the term used in the literature. It was the tail at the end of the dog. It was a consideration. But it was only a minor influence. There were far more important problems.

SUMMARY STATEMENT ON HYPOTHESIS TWELVE

A general theme was developed. But there were inconsistencies. Companies voted that visibility was necessary. But they did not seem to practice what they preached. In the responses to the NCMA questionnaire, it is apparent that delegation of the parameters is only a half-hearted affair. Probably the large and important programs receive the most consideration. It is not unlikely that the smaller programs are virtually ignored after the negotiation. If the negotiation is successful then all the company has to do is manage its budgets. If previous observations were valid as to company goals, then this is what one would have expected. If the large firms are profit satisfiers, risk averse and dominated by technical considerations, then they would be managed accordingly. Given the competitive environment perhaps the cost reduction goals are unfeasible. As noted in the original guide of '62, the government's goal was to get a system that worked, to get it on time, but not at the least cost. The function of the incentive was to control cost overruns. Costs in the envelope of expectation were acceptable. If that were the tack taken by a company there would not have

been any need to have an in-depth organizational implementation. The purpose would be to control costs to not exceed the limits imposed by the contracts.

Yet in Question twelve there was unanimous support for the hypothesis. Incentives have to have organizational visibility to work. What are the implications? One of the keys to motivated behavior is to link the rewards and the drives. Incentives have to be tailored to the needs and wants of the particular contractor. It is not that contractors cannot be motivated. They are motivated to their own goals. Problems occur when goals are imposed that are inconsistent with those already held. Companies make their own goals visible to their organization. They implement it in a variety of ways. One of the most popular is the technique of MBO or managing by objectives. The goals of the company are delegated and integrated into the fabric of the organization. Companies have learned to manage by objectives. And they do. Therefore, the key question is whether the government's goals and the contractor's goals are compatible. Another is whether a firm has to delegate the incentive parameters to achieve its goals. At present most incentive contracts receive very little special treatment.

HYPOTHESIS THIRTEENCPIF CONTRACTS ARE FUNDAMENTALLY THE SAME AS CPFF.

When a CPIF contract is inappropriately structured it can take on the characteristics of a CPFF. For example, if the fee pool was allocated fifty percent to performance and twenty-five percent to schedule then the cost share would be very shallow. If the variables were interdependent the effect would be similar to a CPFF. The contractor could spend as much as was necessary to achieve the goals. As long as he delivered a product that worked, he would get the minimum fee. The original guide and subsequent guides recognized this possibility. It was addressed under a section on massive intentional overruns. Unlimited cost sharing or similar penalties were used to prevent it.

The basic characteristic of the CPFF contract was that it permitted the contractor to spend as much as was necessary to achieve the desired results. His fee amount was fixed, but as the costs exceeded target the percentage decreased. This was not the case with a CPIF. Under the CPIF, the fee amount went down to a prescribed minimum; then it remained fixed as with the CPFF. Unless there are constraints imposed after the minimum is reached the contract is similar to a CPFF.

The purpose of this hypothesis was to determine if industry considered the CPIF like the CPFF. Since the guide used it to replace the CPFF, were the expectations the same? After all it was to be used for development work. What were reasonable expectations concerning final cost variations from estimated targets?

The reason CPFF contracts were used was that everyone recognized the problem of uncertainty. Nobody could define what it was that was to be procured. Has that problem gone away? Are uncertainties any less today than twenty years ago? Or more? Has the product changed? Is the DOD still buying the same things with the CPIF that it used to use the CPFF for? If the answer is yes, should our expectations concerning cost growth and overruns be any different? The question is important because it can provide an appropriate perspective for assessing whether CPIF contracts have worked or not.

THE LITERATURE

It is interesting to reflect on why cost incentives were to be applied to development. Prior to the Sixties, most of the incentives had been applied to the production contracts. Until about the mid-Fifties, most of the research and development costs were written as a part of the end item price. And the percentage for research and development was rather modest. But in the late Fifties research and development costs skyrocketed as weapon systems became more complex. The technological revolution and the expanded knowledge base put more and more dreams into the realm of reality. As the costs of research and development became a larger and larger percentage of the end item price, it finally made sense to break research and development costs out and to manage and contract for them separately.

Prior to the isolation of these costs, and since they did not represent a large percentage of the final costs, the management of research and development was left to industry. But with the demise of the colossal production programs of the Forties and Fifties and with the escalating costs of research and development, it finally became necessary for DOD to get more

deeply involved. Thus, it was decided by DOD to contract for research and development separately. Initially the CPFF contract was used, but its use proved an embarrassment to all. The program's cost far exceeded expectations. The stage was set for the incentive. (7, 10, 12)

The original guide of '62 commented on the CPFF experience. The use of the CPFF contracts had tripled from 1951 to 1961. (13% to 39%) Profits had sagged. Inefficiencies were generally recognized and quality issues were common. Horror stories abounded. Scherer and Peck's Weapon Acquisition book dramatized the problem for all to read. CPFF contracts were the villains. There had to be a change. Overnight, Defense Secretary McNamara converted the CPFF contracts to incentives. In '62 he set a DOD goal to reduce the total back to its '51 level by years end. The Air Force through the Monterey Conference, acted accordingly and quickly implemented the Secretary's demands. In a very short time span of about one year the following actions were taken:

1. In March of '62 the revised ASPR coverage of contract types was published. It stipulated the DOD's preference for fixed price and incentive contracts. It limited the use of retroactive pricing and the CPFF contract.
2. The Air Force Systems Command published its own interim incentive guides on 2 July and 1 August of '62. The first covered cost, schedule, and performance incentives. The latter covered the value engineering incentives.
3. In August of '62 the DOD guide for incentive contracts was published.
4. Between 14 September and 25 October, 1800 Air Force personnel at fourteen centers were indoctrinated through one day training sessions in incentive contracts.

5. On 18 September, the Air Force published its revised guide for pricing (AF70-1-3). For the first time it included a section on incentives. It was based primarily on the material in the ASPR and DOD guide.
6. The DOD contracted with the Ohio State University Research Foundation to conduct two day in-depth training sessions over a six month period throughout the country. It was conducted primarily for procurement personnel.
7. It decided, through industry panels, that the development of standardized performance incentive criteria were not practical.
8. An ASPR subcommittee was appointed to implement the value engineering provisions.
9. A standard FPIS Clause was developed for inclusion in the ASPR.
10. The Air Force revised its AFPI Manuals. (12)

As a result, the Air Force Systems Command usage of the CPFF contract dropped from a high of 66% in FY '62 to 48.5% in FY '63. It was to drop much more. (Newsletter #10, Final Report, USAF, AFSC Management Conference U.S. Naval Postgraduate School, Monterey, California, 1 May '63).

The 1958 Air Force Guide to Contract Types recognized incentives. But it clearly required permission for use. It reminded its' reader that it could not be used unless certain conditions were met. It first had to be determined that such a contract was likely to be less costly than other types of contracts. And it had to be established, that it was improbable that the necessary supplies and services could be obtained without the use of such a contract. It listed eleven factors to be considered in the contract selection. It is

an interesting list. The factors were:

1. The type and complexity of the item.
2. The urgency of the requirement.
3. The period of contract performance.
4. The length of production.
5. The degree of competition.
6. The difficulty of estimating costs.
7. The availability of comparative cost data.
8. The prior experience of the contractor.
9. The technical capability.
10. The financial responsibility.
11. The administrative costs to both parties. (30)

At that time, the Department of Defense was using CPFF contracts extensively. The assumption had to be that the review of this list led logically to the use of the CPFF. Have the conditions changed since that time? Would the review of such a list today lead to a different decision? If so, how have the perceptions changed? What has been learned? Or has a lot of rationalization taken place?

As to its' appropriate usage, the '62 guide provided some guidance. The CPIF contract was to be used if the cost uncertainty exceeded plus or minus 25% of the target cost. The FPI was to be used if the cost variation was in the range of 15 to 25%. (18) Another historical document from '61 is informative of the thinking of that time. NASA, in a guide to contract use, said the place to use the CPIF was when the cost variation was plus or minus 15% (DOD was to say 25%). (31) The Army in a '61 guide to contract selection, noted that incentives up to that time had been used by the Air Force for air

frames and by the Navy in ships but that they had not been widely used by the Army. They thought that the disadvantages outweighed the advantages. They recognized that incentives might encourage efficiency. But the disadvantages were such as to probably preclude their use. These were:

1. They required complicated accounting systems.
2. They increased the cost of administration.
3. It was difficult to establish sound targets, and
4. They shifted the risk to the government.
5. They required experienced and honest contractors.

The Army decided not to use them. In fact, they refused to participate in the early training sessions for their personnel. (32)

As to usage, the '69 guide was informative. It recognized that the appropriate place for the CPFF and the CPAF was where there was an inability to precisely define and measure work objectively. (18)

Another very important statement was added in the '69 draft version. It is one that was often overlooked. It dealt with the meaning of overrun. It read "The term overrun should never be officially used on incentive contracts unless cost performance exceeds the range of incentive effectiveness. On CPFF contracts it would be at the point where cost sharing or a negative fee is achieved. On an FPI it would be at the ceiling price." ('69 DOD guide, Draft Copy)

The guides from the beginning recognized the problem of massive overrun. The '62 guide written by Harbridge House, the '63 DOD guide, the '65 DOD-NASA guide, the '67 NASA guide and the '69 DOD-NASA guides all had sections on protection against massive intentional overrun. The loop was never quite closed, however. Somehow many missed the potential similarity.

Redden, in his '65 study while at the Navy Postgraduate School, gave some subtle hints of the problems. Contractors, he noted, had a disinclination for savings. (52) A CPFF contract or a CPIF appropriately structured could encourage cost incurrence. Bradley and McCuiston also provided perspective, although not commenting directly on the question. They noted that the possibilities of controlling costs are far lower than the possibilities for cost overruns. This would suggest a preference by DOD for cost type contracts and protection. They noted that the contractor can actually negotiate a CPIF that could have a greater potential for cost incurrence than a CPFF contract. (54)

In the '69 Booz-Allen study for NASA, there was a comment on CPFF and incentive contracts. They found that incentives had improved the communication between the parties and they thought there had been an improvement in program definition. (56)

John Cross, of the Institute of Defense Analysis, in a '66 reappraisal of incentives found that cost incentives were generally not very effective. He thought one could do just as well by replacing the CPIF contracts with CPFF and then by selecting the bidder with the lowest fee. He went on to state that the opportunities for cost control in the short run are too nebulous. (59) It was a vote in a sense for the CPFF idea. The CPIF is the CPFF dressed in different clothing.

Hill raised some practical issues. Contractors attempted to satisfy their contract goals at the negotiation table. They were risk averse and profit satisfiers. And when a CPFF/incentive mix was available, there was a tendency to lump personnel and overhead costs on the CPFF contract. That action encouraged overruns on the CPFF contracts. (61)

Berhold, in his UCLA dissertation, studied and compared CPFF and incentive contracts. He recommended direct charge incentives and separate contracts for overhead. On the CPFF he concluded that it was not a zero risk contract. (65) As such it had similarities to the CPIF. In a similar and related study, LMI in '67 studied profits in aerospace. Since the DOD had shifted from CPFF contracts to incentives, the fee levels should have gone up. And the shift from cost to fixed price contracts should also have contributed to higher returns. Actually profits went down from 6.5 to 3.1 percent from '61 to '62, as reported by the renegotiation board. In '64 the DOD formulated a new profit policy. The LMI study was to measure its effect. The profits for contract type for the years '58 through '63 were:

FPR	8.4 % of sales, 9.2% of costs
CPIF	6.7% of sales, 7.2% of costs
CPFF	5.7% of sales, 6.1% of costs

LMI concluded that returns were lower than those of commercial business due to several factors. These were: the severity of the competition, the lower profit goals, the higher degree of unpriced risks, the inadequate specifications, the buy-in, overcapacity, and the government bargaining position. On the surface there was not much difference between the firm fixed price and the CPFF contracts. The profit levels on the CPIF and the CPFF were not very different. There were other benefits of the cost type contracts. Cash flow was a lot better due to the payments provision. (67)

Colonel Troy Jones in his Ohio State doctoral dissertation studied 53 weapon systems in the '63-'64 period. He came up with a long list of observations and conclusions. One particularly pertained to the CPFF-CPIF

comparison. When he eliminated the differences that resulted from the particular types of products being procured, there was no significant difference in cost outcomes among the CPFF, CPIF, or FPIF type contracts. Also, there was no significant difference in change of scope between the CPIF and the CPFF. But he did find a correlation between overruns and changes. On the positive side, there appeared to be more discipline for control of changes under the incentive. (70)

I.N. Fisher of Rand wrote widely on incentives. In a '69 study he concluded that the CPIF had improved several aspects of contracting.

Improvements over the CPFF environment included:

1. Better cost information.
2. Better financial planning.
3. A great awareness of costs.
4. A better attitude toward cost than under the CPFF umbrella. (76)

In '69 Lt. Colonel Alvin Ferhman, attributed a two-billion dollar savings to the shift from CPFF to incentives. He concluded that this had resulted in higher profits for industry. CPFF contracts had been reduced by 75%. (78) Jones and Pierre, in a masters thesis at the Air Force Institute of Technology had a direct comment on the hypothesis of CPFF and CPIF being similar. They warned that without close administration there was a danger that the CPIF could become a CPFF contract. (79) Williams, Cummins and Carter, in '70, in their look at the effectiveness of incentives, concluded that cost growth and average cost modification varies by contract type. It increased from FPI, to CPIF to CPFF. They recommended the de-emphasis of incentives and a return to CPFF and FFP. (80)

Parker in '71 examined recent outcomes of incentives. He followed up on some work done earlier by Dave Belden, who was also from the Air Force Institute of Technology. He studied cost growth, profit, incentive combinations and extra-contractual factors. He found no relationship between contract type and changes. But he did find differences in overruns. CPIF contracts had substantially larger overruns than FPI or CPFF contracts. Research and development averaged greater overruns than production contracts. (82)

Hunt came out for the CPFF over the mechanistic type incentive contracts (CPIF or FPI). In one of several studies, this one with Rubin and Perry, he discouraged the continued use of inflexible, mechanistic FPI and CPIF contracts. He made many observations and recommendations. Many of them have been quoted in other parts of this document. On the subject at hand, he liked the CPAF and the CPFF contracts because they permitted the parties to work the system. He listed several criteria.

Contracts should:

1. Encourage active management.
2. Be reward based.
3. Focus on the problems of the procurement and not on the contract structure.
4. Encourage and facilitate the sharing of information.
5. Convey high levels of expectation consistent with the buyers preferences.
6. Leave the tactical decisions to the company.

Apparently he thought the CPFF and the CPAF met those criteria better than the CPIF or the FPI. (85)

Dixon in a '73 paper felt that the risk was most probably associated with the commodity group and/or industry. The contract type should be tailored to the industry or commodity as appropriate. He found that the cost savings appeared to be fallacious. He divided the incentive effect into two parts; one for efficiency and one for biased estimates. He found little incentive effect. In this context, he suggested that the targets of the incentive were inflated compared to the CPFF. (89) Launer in '74 studied cost growth under cost type incentives. He found that there appeared to be a built-in twenty percent cost growth base for all CPIF contracts. (92)

Crouch, an economics professor at the University of California, made some macro observations in a '78 paper. He observed that the Sixties were probably characterized by unrealistically high targets which resulted in underruns. But the Seventies were just the opposite, the targets were too optimistic, this had resulted in overruns. The problem was faulty targets. (98) David Baron, another professor from Northwestern analyzed the impact of the bidding process on the incentive. Among other conclusions was one that compared the incentive to the CPFF. He found that as the share rate was increased the prices would increase to reflect the increased risk. The net effect could be that the result might not be any better for the buyer than a CPFF. (136)

Professor Scherer, in a '64 paper, found for the 306 contracts studied, that 65% had underruns. Why? He reasoned that if they had wanted to maximize profits they would have negotiated a fixed price contract. (74)

One of the few studies to study contractors behavior when forced to shift from CPFF to CPIF contracts was done by Roberts and Short. The

conclusions were:

1. There was increased attention for control.
2. There was increased relative payoff for skillful negotiation rather than technical performance.
3. There was increased management involvement.
4. There was stalling to let time reduce the uncertainties.
5. There were higher targets. (141)

John McCall of Rand in an early paper theorized on the impact of firm efficiency on bids. Efficient firms, he reasoned, would be driven to submit higher than actual target costs. Just the opposite would happen for inefficient ones. They would be driven to submit bids lower than anticipated. (143) CPFF contractors, assuming that they were inefficient due to the CPFF environment would as a rule, therefore, submit lower bids.

Finally McKean, in a very interesting article, evaluated the nature of the impact of the CPFF contract on government and industry behavior. He argued that both the government and the contractor were forced to accept high risk. Therefore the CPFF was needed. With uncertainty plus size, the risks escalated. The CPFF contract allowed the government and the contractor to defend a wide range of necessary behaviors. With the CPFF, the joint interests of the party biased the cost estimates downward. (144) For CPFF contracts, therefore, overruns would appear to be greater than for the incentive.

In summarizing the literature, the CPFF contract seemed to have its proponents and a function to fulfill. One wonders what would have happened if DOD now had some 65% of its procurements on CPFF. Would the improved

management techniques that have come into being result in a different experience for the CPFF? It is hard to accept that a contractor, if given a blank check, would not be tempted into exploitation. Can the reduced percentage of fee associated with the overrun in cost be an adequate deterrent to cost growth and cost overrun? Hardly. Even the steep shares of the incentives were ineffective. If the utility for cost incurrence is as high as it appears, then the CPFF contract might be too tempting. The CPFF does have a place but it probably is not for large scale complex programs if cost discipline is important. On the other hand, if the goal is to get something soon, the route might be to let a competent contractor "have at it" with minimum guidance and control under a CPFF contract.

THE NCMA QUESTIONNAIRES

Question thirteen from Part Two read: "CPIF contracts are fundamentally the same as CPFF contracts." Zero was agree and nine was disagree. The results were:

	<u>Value</u>	<u>% Response</u>
Agree	0	10
	1	5
	2	12
	3	9
	4	8
	5	7
	6	4
	7	13
	8	11
Disagree	9	21

The top three, from seven to nine accounted for forty-five percent. The bottom three accounted for twenty-seven percent. When the top and bottom four figures are used the scores were forty-nine for the disagree and thirty-one for the agree. When the center is used the responses are 55% for agree and 45% for disagree. On the basis of the results, the hypothesis would have to be modified. There is strong sentiment that the CPIF contract is different.

From the literature, it appears that if the hypothesis were to have read that under certain circumstances the CPIF could be like a CPFF the response would have favored the agree position. What then does the data suggest? It infers that the CPIF can be like the CPFF. After all about 45% of the respondents said it was like the CPFF. Even if only twenty percent of the CPIF contracts ended up like a CPFF it should be a cause for alarm. It could suggest that the government is using the CPIF but wants a CPFF situation.

Since CPFF contracts are unpopular, the structure of the CPIF could be manipulated to make the contract type meet the policy standards. This is the old numbers game gambit. If the boss wants half of his contracts to be FPI then that is what he gets. But the reality might be quite different. He could be getting FPI contracts with price ceilings at one-hundred and forty five percent.

What are the possibilities for making a CPIF a CPFF?

1. A CPFF should be used. Since it is not favorably viewed a CPIF is used. But it is written to provide about the same protection as a CPIF.
2. A multiple incentive is written with a high portion of the fee pool devoted to performance and schedule. There is not unlimited cost sharing. There is a relatively high minimum fee. The result is a CPFF.

3. A CPIF is written with an enormously inflated target cost and flat share on overrun. The protection would be similar to a CPFF.
4. A CPIF is written with an inflated target fee, a high minimum and a distorted cost variation on the overrun side. The effect would be to convert a CPIF into a CPFF situation.

These examples were gathered from the case studies and workshops.

INTERVIEWS AND WORKSHOPS

The attitudes varied somewhat by service. The use of the CPFF and CPIF varied. Historically, the Army was the last to use incentives. And the Navy has shifted to increased use of the award fee. So did NASA. The following summarized the contract usage for FY '81.

<u>Cost Type</u>	<u>Air Force</u>	<u>Army</u>	<u>Navy</u>
CPFF	4.0%	11.5%	16.4%
CPIF	9.2%	9.5%	10.1%
Award Fee	1.7%	2.7%	7.6%
<u>Fixed Price Type</u>			
FPI	17.0%	13.2%	20.3%
FFFP	52.9%	49.2%	41.4%

As the data suggests, the services have different philosophies on contract usage. The Navy used the CPFF contract more than the Army or the Air Force. In fact, the Navy used it four times as much as the Air Force. The Navy was second in usage, and the Air Force was third. The three services had about the same usage of the CPIF (nine to ten percent). The differences in the FPI are striking. The Navy used it the most. (20.3%) This was followed by the Air Force with (17%) and the Army with (13.2%). The use of the award fee

contract differed substantially. The Navy was the big user at 7.6%; the Army was second at 2.7% and the Air Force was last at 1.7%. Part of these differences can be explained by the different product mix that the services acquire. But a key factor probably is the different attitudes toward the contracts. Contract usage changes from year to year. It also seems to exhibit cycles. The usage of one contract will swing up for several years and then reverse. Looking at time period from '71 to date, for DOD totals, the following trends were noted:

1. The fixed price has ranged from about 39% to its recent high of about 48%. The recent trend has been a gradual climb since '78. The fixed price incentives started out at 26% in '71, dipped slowly to 19% in '73, rose in '74 to 21%, dropped again slightly to 17% in '76, rose again to about 20% in '78 and has declined since that time to the FY '81 figure of 13.2%. It currently is at its ten year low.
2. The CPFF contract has ranged from 9% to 13.7%. It has been reasonably steady in the ten to twelve percent range. The nine percent is a ten year low. The CPIF ranged from 7.6% to 11.5%. From '71 to '74 it was about ten percent. It fluctuated slightly from '75 to '77 ending at 11.4%. Since that time there has been a gradual and consistent decline to the current 7.6%.

The Army and the Navy are more relaxed about the use of the CPFF than the Air Force. The Air Force in recent years has dramatically reinforced fixed price type procurements under the "slay" initiatives. This encouraged the use of FPI usage for CPIF situations. On the other hand, the Army was

reluctant from the beginning to use incentive contracts. They have been much more cautious in their application. Since the early Seventies, however, they have used them increasingly. In the opinion of industry, CPI and FFP are being used where cost type contracts should be used. They think that more CPFF contracts might be appropriate. The procurement methodology has improved since the horror days of the late Fifties. Perhaps through program definition and clearer goals the CPFF could be more widely used. Finally, there was general agreement that CPFF contracts had problems of abuse.

SUMMARY COMMENTS ON HYPOTHESIS THIRTEEN.

Cost plus fixed fee contracts were condemned in the late Fifties as the cause of the massive overruns. Overnight the DOD reduced their extensive use. The usage had snowballed from thirteen percent to thirty-nine percent between 1951 and 1961. Then it tumbled from thirty-nine to twelve percent by '64. Individual services even had much higher usages. Did the DOD replace it with a contract that could be essentially the same arrangement on cost incurrence? The Air Force, for example, has gone from 65% in FY '62 to the current 1981 total of 4%. That is a most dramatic change. Only slightly over nine percent were on CPIF in FY '81. So for the Air Force it would be difficult to make an argument that the CPFF has been replaced by the CPIF. For DOD only 22.3 percent of its awards were on cost type contracts in FY '81. The Navy had thirty-four percent, the Army had about twenty-eight percent and the Air Force had about fourteen percent.

Clearly the CPFF contracts were replaced by shifting to incentives and the fixed price contract.

What has been learned? The following is offered.

1. The literature was reasonably consistent that CPIF contracts had not significantly increased efficiency. They did, however, result in improved communication, improved program definition and more concerned attitudes toward costs.
2. CPFF contractors were likely to submit high targets. CPIF contractors were likely to do the opposite. The results, therefore, had to be judged accordingly.
3. Contractors often have a disutility for cost savings. They tend to expend dollars. CPFF contracts encourage this propensity.
4. Contractors are risk averse. Cost contracts provide protection. Protection might make contractors lazy and inefficient.
5. Cost contracts permit contractors to shift overhead and personnel charges among contracts.
6. Cost contracts encourage buy-ins.
7. Unless carefully administered, a CPIF can become a CPFF contract.
8. Changes in scope seem to be the same for CPIF and CPFF contracts. (70)
9. The services' attitudes toward contract use varies substantially. The Air Force usage was 4%, the Navy 16.4%, and the Army 11.5% for CPFF contracts in FY '81. Their use of CPIF was about the same at about 10%.
10. On the questionnaire, the results were that many CPIF's are like CPFF. In the interviews, the results were that abuses of cost contracts were recognized. But a proper use of the CPFF exists. Unless administered it can and does lead to inefficiencies. Bottom line: Cost type incentive contracts can be like CPFF but they need not. And there are situations of high uncertainty where they are appropriate.

HYPOTHESIS FOURTEENCOST TYPE CONTRACTS RESULT IN INEFFICIENT HIGH COST PRODUCERS.

One of the major concerns of Karl Vinson in his rampage against the defense industry was their alleged inefficiency. He put the blame squarely on the shoulders of the cost type contracts. Not only the CPFF contract came under his wrath, the cost plus an incentive fee was also viewed as a giveaway. All cost type contract lead to inefficiency and waste. He fought the good fight for decades. He was one of several members of Congress who continually ridiculed and condemned the Department of Defense acquisition programs.

THE LITERATURE

The criticisms had been voiced since the Civil War. But the voices reached a clamor for reform only after the experience of cost plus a percentage of cost in the Second World War. Accusations were rampant that companies had taken advantage of the war time situations to reap high fortunes. Even industry had voiced concerns.

One of the major issues at the '62 Monterey Conference was whether the CPFF contracts had fostered a lethargic unfit industry. Did DOD spoil its child by too easy an access to dollars? The general consensus was that there was some truth in the statement. At that time both Allen, of Boeing and Pratt, of Pratt and Whitney, spoke of the insidious nature of cost contracts. They thought that they made companies fat and lazy. Neither company would accept them. They wanted a fixed price environment. (Minutes, Monterey Conference, AFSC, June '62.)

There were other points of view. For example, Richard Tybout, of the University of Michigan thought the CPFF was "the administrative contract

par excellence." "For the market mechanism it substituted the administrative mechanism. For the profit share of private entrepreneurs, it substituted the fixed fee, a payment in lieu of profits foregone, and for the independent private business unit, it substituted a hierarchical structure of an organization composed of an agency and its contractors." Weidenbaum agreed with Tybout and quoted him on the point. (Murray L. Weidenbaum, Working Paper, Washington Univ., '66 3 656 6531).

Weidenbaum, the recent chairman of President Reagan's economic advisors wrote several articles on defense economics in the Sixties. In one of these he considered the problems that the aerospace firms had in diversifying into the private sector. Part of the problem he concluded was their cost plus environment. He noted several weaknesses. Among them was "their lack of marketing capability and their inability to produce large numbers of items of low unit price." Part of the problem he thought was the lack of emphasis on low price in the aerospace market. The market rewarded technical competence first and foremost. Price often came a poor third. (37, 45)

Hill pictured aerospace contractors as risk averters and profit satisfiers. They placed great emphasis on meeting and surpassing performance and schedule goals. When a CPFF contract mix was available they would readily trade off personnel and overhead costs onto the CPFF. (61)

Redden in '65, while at the Naval Postgraduate School, studied the use of incentives for aircraft. In it he made certain relevant findings on the CPFF contract versus the incentive. Contractors, he thought, had a low utility for savings. They spent to enhance performance. (52) In that same year, Bradley and McCuiston found that the uncertainties of overrun exceeded the

possibilities for underrun. The contractor was not motivated to efficient operation. (54) If this were true for the CPIF, what must it have been for the CPFF?

Booz -Allen studied NASA's incentive contracts and published their findings in '65. They found that much of the improvement from incentives was attributable to the improved program definition. Again there was a suggestion that the management of the CPFF was rather loose. (56) Cross, in a '66 study done for the Institute of Defense Analysis, found that incentives had not increased contractor efficiency commensurate with the benefits paid. He concluded that cost incentives were not very efficient. Performance incentives did have merit and reduced the risk. Cross seemed to say that if the contractors were inefficient under CPFF contracts, they remained so under the CPIF contract. (59)

Marvin Berhold, in his doctoral dissertation at UCIA, made an analysis of incentives. He attempted to apply an analytical decision framework to the problems of contractor motivation. One of his conclusions is applicable. He recommended that CPFF contracts not be considered zero risk contracts. Given the goals of the corporation a lot was at stake. (65) LMI studied DOD profits by contract types in '67. They compared profits in the '58 to '66 period. The returns did not seem to reflect the increased risks associated with the use of the incentive. The return on costs for the CPFF was 6.1%. For the CPIF it was 7.2%. The inference is that the companies were not able to significantly reduce costs through increased efficiencies on the incentives. Or they chose not to do so due to their low utility for savings. LMI cited a long list of problems supplied by industry. (67)

Colonel Troy Jones touched on the efficiency problem. He evaluated the USAF experience with incentives in the early Sixties. Generally he found that there was little evidence to show that incentives had been successful in preventing cost growth. If adjustments were made for product categories, there were no differences in cost outcomes among the CPFF, CPIC and FPI. On the efficiency question he found that the incentive had resulted in a better discipline on both the government and industry sides. (70) LMI in another look at the problem concluded similarly in '68. Cost incentives did not work. Performance and schedule ones might. But the requirements, determination and program definition was more complete and thorough. And the structures helped communicate the government's goals to industry. They suggested an improvement in management all around. (74)

Fisher of Rand, in his several studies, focused on the efficiency aspect. He doubted that the CPIC had improved much over the CPFF. He felt that the appearances of cost control were due to either inflated targets or changes. But incentives had advantages. They had resulted in better cost information. And they probably made the government and industry more cost conscious. He thus suggested that the problem of lack of interest in costs was a problem under the CPFF. (76) In another study done in '69, he concluded that the underruns observed could not be attributed to increased efficiency. (76)

On a different tack, Ferhman in an Air University study, concluded that incentives had produced substantial savings. They were a result of the shift from CPFF to incentives. (78) Julius Jones and Russell Pierre, in a masters thesis at the Air Force Institute of Technology, agreed and endorsed the incentive contract. They said it worked. They were unable to verify inflated targets as the reason for the prior underruns. (79) They inferred that the

CPFF environment had been characterized by wastefulness and inefficiency. The changes made in the period since '62 had helped change this.

Williams, Cummins, and Carter disagreed in a U.S. Army Procurement Research Office study of '70. Incentive provisions had very little impact on cost overruns. They felt one should return to the CPFF contract. The improvements were due to the better planning, organization and control. These should be retained and used with the CPFF and the FFP. (80)

Parker of the Navy added a new observation in a study in '71. He said that there was no evidence that contractors had gotten well through changes. And CPIF contracts averaged larger overruns than CPFF contracts. (82) Also in '71, Air Force Captain Jerry Trimble did not find any increased efficiency in the use of incentive contracts in the contractors' utilization of their labor or capital. The profits of the contractors did not show any improvement of efficiency over the CPFF contract. (84)

Hunt in several papers suggested that mechanistic contracts inherently should not be more efficient than more flexible arrangements. He argued a very thorough case for the CPAF type contract. The CPFF was recommended over the traditional CPIF and FPI contract. (85, 117)

Dixon, in a Naval Postgraduate study, agreed. There was no evidence to support the contention of increased efficiency through the use of the incentive contract. The problem, he concluded, was the nature and extent of the risk inherent in the programs being procured. (89)

William Hill and Peter Shepard, two Lieutenants of the Navy, researched the effectiveness of incentives as motivators. In a paper done in '73 at the Naval Postgraduate School, they concluded that all contracts were alike to

contractors. And since the contract type was not the determining factor, other aspects must dominate. (90)

Mundhenk made a vital point in a '74 study. He looked at several programs to determine what was right and what was wrong among procurement methods. He concluded that the contract must be tailored to the situation. (91) Ehner and Kaiser in '76 agreed. The contract did not affect contractor performance. While Captains at the Air Force Institute of Technology, they studied civil engineering service contracts. They questioned whether the increased use of incentives was appropriate for service contracts. (95)

What seemed to be the problem? Why didn't the contract type make a difference? Perhaps the contractors basic motivations were the key. This was Phillip Oppendahl's conclusion in a '77 study. Commander Oppendahl, while at the Defense Management College did a very interesting study of contractor motivation. He concluded that the drives of the contractors do not often match those imposed in the contracts. Contractors want to incur costs to grow and to become technically dominant. (95) They might attempt to do so in spite of or because of the contract type.

Lynch and Pappas in '77 provided a possible key to the efficiency problem. In a School of Logistics study, they noted that the answer was to place incentives on overhead and direct costs. Indirect costs and subcontracted costs together averaged fifty four percent. (97) Another possible answer was given by Crouch, a professor of economics at the University of California in a short '78 paper. He, like Fisher and McKean before him in the Sixties, said the problem with incentives was the inability to accurately estimate target cost. He suggested going out on bids for estimating. (98)

Another interesting paper was that of McCall in '64. He hypothesized that in competitive procurements firms are driven to submit higher than actual costs. Inefficient firms do the opposite. They submit lower than anticipated contract costs. (144) Therefore, overruns are illustrative of inefficient firms.

A final paper from the literature is that of Oliver Williams of Rand, written in '65. He provided an interesting clue to the mystery of the seeming insensitivity of contractors to contract type. It was their level of adaptive response. They could adjust and adapt and absorb through a wide range of techniques. (145) Presumably he meant that the contractor could shift costs among contracts, inflate targets and negotiate protective contract structures to negate the risk aspects of the particular contract situation.

A related aspect of the problem of efficiency is cost growth. The problems of cost growth are intimately linked to the effectiveness of the incentive. If there had been substantial cost growth, how did it impact on the contract structure? Were incentives successful in eliminating cost growth? IN FY '71 through '81 data suggest the answer is no. Interim and final costs of programs consistently dwarf the original estimates. This is because optimism abounds in the earlier stages of the programs; mutual buy-ins occur; industry invests in technology for follow-ons; and more items are bought. At a recent Army conference in July '82 the cost growth problem was addressed. It is appropriate to end this section with some of its conclusions. The paper, "Cost Discipline Report" highlighted the following:

1. Cost growth was not the primary problem.
2. Program instability was the fundamental problem.
3. The highly competitive defense industry contributed.

4. Inflation was a second-order effect of the fundamental problem.

(Cost Discipline Report, American Defense Preparedness Association, Chicago,

IL. July '82: Published by Advanced Technology, McLean, VA).

THE NCMA QUESTIONNAIRE

The relationship of cost contracts to efficiency is complex. One has to consider the company's goals before one can assess its efficiency. An outsider imposing the traditional commercial sector's goals can easily be misled. What are the goals of the aerospace company? How does this company, for example, act in negotiation? Is the contract type the determining variable in the contractor's behavior? In short, what makes the company tick?

For example, it might well be that the company is achieving its goals very nicely by incurring costs to invest in technology. It might be the most economically sound decision that the company could make based on its options. An outsider might conclude that the firm was inefficient. And he might conclude that the contract did not work. The NCMA questionnaire was designed to address this issue. The questions attempted to relate goals and behavior to contract type.

Questions seven through twelve are applicable. Questions seventeen to twenty-one also had a direct bearing. Questions twenty-four through twenty-eight, and questions thirty-three and thirty-four added perspective. In Part Two, most all of the questions had some bearing, but question fourteen was the most applicable.

Summarizing from the earlier hypothesis on the questions noted above, the following is offered. Contractors, particularly the larger ones, are risk averse and profit satisfiers. They have a low utility for cost savings.

They readily slip cost and schedule to achieve technical goals. Their major motivators include technical achievement, long run satisfactory profits, prestige, market dominance, development for commercial products, follow-on business and power. Apparently, their goals can be most easily met by high technical achievement. They attempt to minimize their risks at the negotiation table. They assume that changes will provide an opportunity for the readjustment of price. Buying-in is practiced where necessary and logical. Short run cost savings are difficult to achieve. The emphasis is usually on protection on the overrun side of the target. The contractors already have management and control systems in place. But these are not modified to any great extent for a particular contract. Large important programs might be the exception. Extra-contractual factors dominate the thinking and time of management. The unknown-unknowns create an atmosphere of uncertainty. Change is a constant companion.

Question fourteen read: "Cost contracts result in inefficient high cost producers." Zero was agree and nine was disagree. The results were:

	<u>Value</u>	<u>% Response</u>
Agree	0	9
	1	5
	2	9
	3	11
	4	9
	5	8
	6	5
	7	11
	8	15
Disagree	9	18

There was strong disagreement with this proposition. But it was not all one sided. The seven to nine disagree readings totaled forty-four percent. It was twice as high as the zero to two which totaled twenty-three percent. There were thirty-four percent at the zero to three level (agree).

The results were somewhat surprising. The literature all the way back to World War II is replete with condemnation of cost contracts. The cases of abuse in the General Accounting Office reports and the Congressional Hearings attested that cost contracts led to inefficient contractors. Apparently there are large segments of contractors that disagreed. Could it vary by product or size? The following explored this possibility.

	<u>ALL</u>		<u>AIR FRAME</u>		<u>ELECTRONICS</u>		<u>PROPULSION</u>		<u>MUNITIONS</u>	
	%	#	%	#	%	#	%	#	%	#
0	9	44	11	6	7	13	9	4	8	2
1	5	24	7	4	4	6	5	2	0	0
2	9	57	8	4	8	13	7	3	15	4
3	11	41	1	6	13	23	11	5	4	1
4	8	32	3	2	5	9	7	3	12	3
5	7	26	13	7	8	14	16	7	7	2
6	5	21	2	5	4	7	9	4	4	1
7	11	60	11	6	14	25	6	3	8	2
8	15	51	10	5	15	26	18	8	23	6
9	18	97	16	9	19	33	12	5	19	5

The munitions group evidenced stronger disagreement than the others. They scored over fifty percent at the seven, eight, and nine level. There was particularly strong attitudes at the eight and nine level which totaled forty-two percent. The average of the group at that level was thirty-three percent.

Air Frame was the lowest at twenty-six percent. A number of interesting questions can be raised. For example, if munitions are procured primarily by the Army through the CPFF contract, how would that bias the responses? Similarly, if the air frames were produced by the Air Force primarily through FPI contracts, how would that bias the responses? Traditionally, munitions have been the domain of the Army. Air frames have been handled by the Air Force. To what extent did these relationships influence the perception of the CPFF contract and its impact on efficiency?

What can be concluded from the questionnaire data? The hypothesis, on this basis alone would have to be rejected. The munitions, the propulsion, and the electronic groups all had strong support at the disagree positions. The air frame data was rather evenly spread and indicated a mix of opinions. But the problem is there. And it exists widely enough to be a concern to many. Perhaps the disciplines imposed over the last twenty years, plus the typical contract mix precludes the cost mentality from existing as it did in the post World War II era.

INTERVIEWS AND WORKSHOPS

Many of the questions noted above lent themselves to workshop discussion. And these kinds of questions came up all the time. The key question was whether cost contracts resulted in inefficient contractors. If the question had been, did CPFF contracts lead to cost inefficiency, the answer in all probability would have been unanimously yes. But CPIF contracts clouded the issue. There was no agreement that CPIF contracts, if properly structured, resulted in inefficient producers. CPIF contracts can lead to inefficiency. But if they do it is because the contract was not properly structured or administered. Or it was because of extra-contractual influences. Several

points and questions came up often enough to be noted. These were as follows:

1. Should the concept of cost efficiency be applied to the development of weapon systems? In this context, under what conditions does creativity flourish?
2. Can economic criteria be applied to an essentially non-economic endeavor?
3. The CPFF contract and the CPIF contracts can both be used for a mutual buy-in.
4. The attitude toward profits has reduced the contractors utility for savings; conversely, it has increased the utility (propensity) to incur costs.
5. Contractors probably cannot execute cost reductions in the short run. This is due to the nature of the business. (See Hypotheses Two and Three) As a result the apparent overruns may not be due to inefficiency. It might well be due to uncertainty and its results. Change has the greatest impact on estimated costs. Competition also adds fuel to the fire. And the government-industry partnership and its ramifications plays a role.
6. The nature of the product affects efficiency. Advancing technology assures rapid obsolescence. Before the product is ready for production and use it is obsolete. The life cycles are getting shorter and shorter. Long production runs are a thing of antiquity. There is never a chance to obtain learning to effect efficiency. We are constantly involved in a hand made job shop type operation.

7. The market place does not encourage or reward efficiency. It rewards technical excellence, the ability to manage complex systems, and the capacity to handle emergency requirements. A company has to have on hand, however inefficient it might be, the manpower and the tools to bid and execute technically and financially staggeringly risky undertakings in aerospace. It does not lend itself to the applications of Frederic W. Taylor's "one best way". Companies with minimum staffs, minimum capacity, minimum facilities and the minimum capacity to react do not get contracts.

SUMMARY STATEMENT ON HYPOTHESIS FOURTEEN

History and the literature found the party guilty as charged. A cost type atmosphere such as cost plus a percentage of cost led to abuses and lethargic, high cost producers. And the CPIF contract apparently has not solved the problem. Most of the studies concluded that there was not any evidence of increased efficiency due to the employment of the cost incentive contract. But there were some positive results. Other aspects of the procurement process have improved. Increased attention to costs and to program definition and an improved communication among the contracting parties have resulted. What about the overruns? What about cost growth? Had incentives helped cure the disease that Scherer and Peck highlighted in their '62 book on weapons acquisitions? They had alleged overruns averaging between 70 and 700 percent.

Is the above consistent with the data for Hypothesis Fourteen? The literature concluded that the incentive contract did not necessarily result in increased efficiency. It did result in improved cost consciousness and

program management. Improvements were noted in communication and program definition. The procurement environment of the DAR has upgraded contractor management and the government's ability to plan, develop and deliver complex systems.

The NCMA questionnaire data posed some interesting questions. Apparently, industry is mixed on the issue. The question however might have been misleading. It probably should have specified the CPFF contract. From the question it was not clear if it was about cost incentives and/or CPFF contracts. In either event, a good segment agreed on it leading to inefficiency. But there was strong sentiment that cost contracts, in and of themselves, do not have to lead to inefficient producers.

The pilot studies and the workshops permitted exploration of this possible dichotomy. And the results were strongly that CPFF type contracts can and often do lead to lazy, cost careless, lethargic organizations. The general consensus was that cost contracts lead to loss of discipline.

Overall the conclusion was that cost contracts can and usually do lead to inefficient producers. It does not have to lead to low quality or late schedules. Therein lies part of the problem. High quality producers might not be cost efficient in the research and development sphere. Cost type contracts probably lead to a careless attitude toward costs. But they might also provide the flexibility necessary to adjust to the unrelenting demands of uncertainty. And for the areas of high risk they might be the necessary price for the solution of technical problems and the assurance of high quality and reliability.

II

VOLUME II

PILOT STUDY

INTRODUCTION

From the literature search one would have to conclude that there is something wrong with the very fundamental assumptions on incentive contracts. The voices of past researchers can be heard echoing the phrase "Isn't anybody out there listening?" The literature raised very serious questions concerning the basic assumptions on which the incentive contract philosophy was originally constructed. Of all the documents reviewed the author can recall only one or two brave souls that gave incentives a full endorsement on their achievements to date.

But are they right? Are incentives ineffective? Or are they misapplied or poorly constructed? To properly judge their relative merit it is necessary to clearly understand their original intent. A criteria must be established. According to the literature their intent was to control costs, and to get a product that worked on time. The purpose was to "harness the profit motive" to motivate contractors to do a better job of management. Presumably the targets of the incentives would be used by the companies to provide carrots to their people. The incentives were to be used to build motivation for the team. Thus a key element in assessing incentives is how they are used by companies in the management of the programs.

This is precisely the focus of this part of the research project. How do companies utilize the incentive? What impact does it have on corporate behavior? To find out, the author decided to go into the companies and to observe their behavior. Toward that end, several firms were studied at length: of these, one company permitted an exhaustive evaluation. This sample was enlarged through company workshops sponsored by the NCMA, and by other

companies visited on the author's own initiative.⁽¹⁾ From these two hypothetical models were developed; Pilot X represents small privately held firms with sales from 15 to 60 million, Pilot Y depicts a large aerospace prime.

The two pilot case reports address fourteen areas: 1. A general description of the company; 2. the contract and the contracts department; 3. the competitive environment; 4. the accounting and financial system; 5. the government environment; 6. the negotiation process; 7. company goals and outcomes; 8. the contractual period of performance; 9. the government administration process; 10. organizational problems that affect the incentive; 11. the organizational behavior of the company; 12. personalities; 13. general conclusions; and 14. specific insights on the original hypothesis.

The pilot studies were most revealing; there are problems. For example, incentive contracts are not implemented within the organization. And there are constant changes in the program. These changes by the government and the companies often nullify any latent possibility for motivation under the incentive. Further, the cumbersome overkill of the government administrative process restricts the flexibility of the contracting parties to respond to needs as they arise. This, too, negates the opportunity for positive corrective action. Also profit levels are too low to offset extra-contractual options. The original intent of the parties appears to be to spend to target, not to underrun.

Many of the factors in the contractual environment drive the costs to a point somewhere between target and ceilings. Thus, contractors attempt to minimize risk and not to maximize profit in the short run. Survival means more than a few more percent of profit. Current investment in research and development

⁽¹⁾ Over twenty companies participated.

can help assure that survival. Hence, spend available dollars to assure a future competitive edge. These are but a few of the findings. What are emerging are patterns of corporate and government behavior that somehow get the job done even in this most complex of business situations.

Before delving into the findings on the pilot studies, one or two comments are appropriate to assist the reader in using this volume and the other two that comprise this study. There are three volumes to this work, of which this is Volume Two. Volume One provides the final conclusions and recommendations. It uses the data from Volumes Two and Three. Volume Three synthesizes the literature on incentives from the last forty years. Much of the literature is dated from the mid-Fifties. Included in Volume Three is a comprehensive bibliography covering some 485 documents. Throughout Volumes One and Two the footnotes on references refer to the page in Volume Three in which the synopsis of the work can be found. It does not relate to the bibliography number.

A final note, these case studies can be much better appreciated if a review of Volume Three were first made. If the reader does not have adequate time to read it in its entirety, at least the section on the research studies should be scoped. But this Volume, as well as Volumes One and Three are written so that they can be read and considered separately.

The reader's attention is now directed to the balance of this document to Cases X and Y on what really happens inside a company once an incentive is negotiated. The reader should find the material interesting and provocative. Hopefully it can help in assessing reality. In any event, further study is necessary to fully document the findings.

COMPANY X

Description of Company

Company X is a privately held corporation with sales approaching forty million dollars. It is a prime contractor with two hundred fifty employees. Its products are electromechanical devices for the Air Force, Army and other prime aerospace companies. It has experienced rapid growth over the last ten year period and is a recognized producer in its market niches. The company has approximately six product areas. It dominates or has a major market share in two of the six markets. It is a high technology company specializing in the development and manufacture of ancillary equipment for weapon systems. The company is dominated by engineers and scientists. Over the last ten years the government-commercial mix has varied but at the time of the study, about eighty percent of the sales were government. Almost ninety percent of the business is acquired through the bid process. One hundred percent of the stock of Company X is owned by its chairman of the board. The particular procurement studied is described below.

The Contract and the Contracts Department²

The first phase of the procurement studies was a prototype development under a "cost plus a fixed fee" contract with a USAF buying activity. During this initial stage the buying authority was transferred by the Air Force to the major system contractor. Phase Two of the procurement was awarded on a fixed price incentive contract after a competition that included three best and finals. The fixed price incentive had a target fee of 11.5% and a price ceiling of 130%. There were requirements for five preproduction units plus a large number of production units, first article test, auxiliary units,

²See Section II on contracts, Phase One study, Incentive Contracts, Kennedy, John.

accessories and data. At the outset of the contract, the firm had very little appreciation of what incentive contracts were. In the contract section of the company only two people had prior experience with the incentive. One was a former contracts specialist with an aerospace prime about 48 years old and the other a former government employee in his late 50's. Neither had any line authority in the corporation.

Competitive Environment³

The competition varied by product line which ranged from homogeneous products where awards were based on price to highly differentiated technological products where the awards were made primarily on technical considerations. In its principal market, the company battled aerospace giants.

Each competitor developed prototypes at their own expense. This is typical of the industry; large amounts of front end capital is often required to participate. One-half to several million dollars is not uncommon. Awards are few. Generally, the contracts are sizable and often exceed fifty million dollars. The competition was intense. The company was awarded the contract after a fierce, lengthy battle.

The subcontract structure consisted primarily of major component manufacturers. Although the system has several subassemblies which could be readily subcontracted, the Air Force chose to procure the entire system from one contractor. It was anticipated that as the specifications became firm some parts of the system would be bid competitively. A major strategy of the company was to retain as much as possible of the total system.⁴ This goal had a

³ See for example: Major Factors for Consideration in Obtaining Military Research and Development Contracts, Mahoney, Major John J. (34); also Competition in High Technology Government Markets, Weidenbaum, Murray (47).

⁴ Mahoney, Major John J., Factors for Consideration in Obtaining Military Research and Development Contracts, (34) and McKean (144).

dominant impact on company behavior. The subcontract structure was very competitive. The major sub-assemblies could have been subcontracted by the Air Force to large, more efficient producers. Thus, from the outset, there was a dilemma. To add to the problem the company had difficulty competing financially with the existing manufacturers. This goal to capture and retain the entire contract offset the short run goal of potential increased profit.

Another factor was of a personal nature. One of the major subcontractors attempted to bypass pilot Company X by going directly to the Air Force. This infuriated Company X's chairman and president. Over the period of the study the owners of these two companies became almost personally combative. The goal of each of these companies was to destroy each other. Both projected images to outsiders of the other as ruthless and dishonest. It is hard to dismiss the personal element that exists among close competitors and their desire to beat the "other guy at the game." This particular facet is often awkward to observe and document. In this particular procurement it played an important role. It is an excellent example of an extra-contractual motivator dominating the behavior of the producer and offsetting the goals of the incentive.

Accounting and Financial Systems

The pilot company used a simple job order accounting system; the computer was utilized primarily for payroll. The pretax commercial profit margins approached twenty percent. The company was not familiar with progress payments; they did not understand the administrative demands of government contracts. A new accounting system had to be designed and installed to accommodate the CSSR requirements. Unfortunately the CSSR required a work breakdown structure that was inconsistent with a DCAS progress payment requirement. The company

did not have a management information system capable of providing the data necessary to make necessary trade-off decisions. Over the performance period many changes had to be made to meet the demands of DCAS and DCAA.

The company did not have confidence in their own cost estimates. Debate was constant and bitter. Specifically, engineers differed with the program managers and the marketing representatives. During the study period, cost estimates were constantly changed. This was caused by several factors. Also the contracting officer disclosed to the competitors the amount of dollars in the budget. Then the best and final exercise resulted in the company buying the business with the hope of getting even. In summary the accounting system provided after the fact data that was at best only good in the aggregate. Arguments constantly and routinely arose over appropriate rates to charge to the various divisions of the business; nobody could agree on cost estimates. For example, the program managers usually complained that their assigned overhead and G & A rates were too high; in the morning staff meetings it became obvious that there was no agreement on costs.

From the above, several observations are appropriate on the effectiveness of the incentive: 1. Do typical information systems provide the data necessary for management of an incentive contract? I think not. 2. Are the data requirements imposed on contractors meaningful, necessary and consistent? I think not. 3. It is questionable to impose an incentive on a contractor whose accounting system is incapable of providing the data necessary for its management, and 4. At best the incentive must be appropriately structured to take into consideration the organization of the company and its accounting and financial systems.

These observations have many implications. For example, in a competitive procurement should the bid require a particular contract type? Should the

contract be a function of the particular contractor? Is DOD imposing unreasonable requirements for data? What are the minimum accounting system requirements to provide management capability for an incentive contract?

The Government Environment⁵

There were a variety of attitude and behavioral patterns of the government that affected contract outcomes. These varied over time, by command and by agency. The overriding atmosphere was one of benevolence and perhaps paternalism. In a sense it was a father-son, parent-daughter interaction and relationship. Both parties knew who was boss. As long as all went well the atmosphere was relaxed. However, when father wanted things done they were going to be done his way. If friendly persuasion worked, all well and good. If not, then it was time to bring out the big stick. The buyer and the marketing representative had a different relationship than that between the commanding general and the chairman of the board of the company. The relationship of the small business office representative was different than that of the audit team.

Some generalizations can be offered. The government required and in fact covertly demanded work outside the scope of the contract. This was done on a quid pro quo basis. The company learned quickly to develop an informal working relationship to get the job done. Changes, increased scope, testing new ideas, spending one's own dollars with the promise of getting even were all part of the game. It was an excellent example of groups working toward their assigned goals in the most expeditious manner possible. This company found it advantageous to cooperate in achieving the goals of the customer (DOD). Often-time

⁵Government Procurement Policy: A Survey of Strategies and Techniques, Lank, Barry R.. (16); also Defense Industry Complex, Fletcher, Alec A. (43) ;also "Historical Development of Procurement Methods," Jarrett, C.E., Cox, E. (15).

the career aspirations of the government personnel were tied to the relative success of the program. In the most successful programs it might be that the contractor and the government team work together to "get the job done." The job does not get done necessarily by the rules. This relationship does not occur overnight. Rather, the informal expeditious actions occurred only after the parties were well into the contract. An adversarial role did not develop except in rare situations once the program got underway. The difficulties that did arise concerned the final redetermination of the contract. The most aggressive and devisive actions came from government lower and middle managers who occasionally swaggered and imposed their authority even on the president of the company. On the surface it appeared as if minor government officials enjoyed their power and the use thereof by imposing their will on "important" people. Through this exercise of their power and their association with company presidents they possibly enhanced their own egos. This was not uncommon. The validity of the observation is another matter. It is rather a human phenomenon, and even if valid it might be difficult to correct.

Another factor was the unreliability of government actions. The company was never certain of proposed government intentions; the government changed the parameters regularly. This occurred over the entire time span of the author's observations. There is no doubt that paramount among the factors influencing contractor behavior is this uncertainty. In this pilot study it was perhaps the major influence. Will the government buy the system? Will it be funded in the Senate? When will it be bought? When will funds be made available? Once the contract is awarded will the follow-on production be implemented? All programs are not alike; but they have similar elements. The uncertainty associated with the government program often leads contractors to

be risk averters.⁶ This has been discussed by other researchers. If the profit level is reasonably fixed and the risks of uncertainty are manifest and significant, what are the reasonable goals of the negotiation process. Perhaps protection is the most important driver in contractor behavior. This is pursued in the next section.

The Negotiation Process⁷

An incentive contract succeeds or fails at the negotiation table. This is among the common wisdom of aerospace lore. What are its implications? How does the negotiation process affect contract outcomes? For the contract studied the contractor responded with the contract type imposed by the government. The item being procured was a development item that had never been manufactured before. It had been for all purposes hand tooled and hand assembled on a trial and error basis. Drawings were in a state of constant flux; so were the user's requirements. Both the contractor and the government struggled to define the precise needs and technical parameters of the requirement. At the time of the technical flyoff drawings were still not complete, elements of the product were already identified for change, and customer "suggestions" were common. Consequently the contractor was required to quote a production price for an item that was still in development in a competitive atmosphere, and on a procurement that was to be the only one of its kind in the pipeline for several years. In the vernacular of the street, it was the only game in town. The goal was to win . . . even at break even or at a loss.

⁶ Federal Procurement: A Study of Some Pertinent Properties, Policies and Practices of a Group of Business Organizations, Hunt, Raymond G.; Rubin, I.S. and Perry, F.A., Jr. (117); See also work of McKean (144).

⁷ Negotiation Handbook, U. S. Army (7).

The company hoped to "get even" through changes. There were three best and finals; and there were technical and cost leakages concerning the competitive technical and pricing approaches. These came from the trade as well as from the government. The government leaks came both from the audit groups as well as from the buying activity. Within the buying activity they came from the engineers as well as the systems program office procurement function. All contractors had by this time found out the amount of money in the budget for the current fiscal year. Program changes had to be made to live within the imposed restrictions. Could other "pots" of money be found to help? Can part of the program be handled by the prime weapon contractor within the scope of his program? How can we get the job done?

The company in this atmosphere was concerned about getting the program and then surviving with a reasonable profit. The mentality of the management was to look carefully at the price ceiling and the break point, the potential for changes, the possibilities of significant cost reductions through cost efficiencies, possible technical improvements in design, and other potential improvement through the management of the program.⁸

At the time of the negotiation there was not any general agreement in the company about the projected costs or the schedule. The chief of engineering and the vice president of finance objected to the proposed negotiated target cost. Subsequently a few months after the award, significant changes were being made to the contract on a "not-to-exceed basis." These included contract changes to modify the first article test requirements, to completely overhaul data requirements, to order refurbishment of the two prototypes, to

⁸For a discussion of contract motivation see Section VIII, Phase I study, Incentive Contracts, Kennedy, John J.

order engineering studies, and to add field services. Some of these were de-finitized as part of the original incentive contract and some as fixed price additions. It is safe to say after the negotiation and award that few people in the organization knew at any time the type of contract. This further impacted on accounting in that the CSSR system covered the incentive portion of the contract but excluded the fixed price and the cost reimbursement portions. Two years after the award, fixed price work continued to be added to the contract. Since progress payments must continue to show all the costs from the beginning, the DCAS paying office did not know where it was relative to the payments to date. Further, there were 35 line items under the incentive provisions and 63 items that were not part of the incentive. In light of the above it is reasonably safe to conclude that any plans made at the negotiation table concerning the achievement of the goals of the incentive had been negated through: 1) the constant changes and 2) the inability to manage the impact thereof.

The predispositions of the bargaining parties were revealing. For example, the attitude of the government precontract audit team that visited the contractor's facilities was adversarial. The contractor was viewed as dishonest or inept. A paternalism might best describe many of the interchanges; and too often the contractor assumed the government was incompetent and too often the government assumed that the contractor was unethical. Does this expectation invite the very behavior that it attempts to avoid? What impact does this gamesmanship have on the negotiation process? Is the implied ceiling on profit an invitation to the contractor to obtain benefits in another area other than short-run after tax dollars? Are the dominant goals 1) the minimization of risk and 2) a target profit consistent with the corporate expectation? Certainly in this case they were.

Company Goals and Outcomes⁹

It was hard to clearly isolate the goals of the pilot study company. Although the author was not present at all of the negotiation sessions he did interact regularly with the key individuals. Several observations from those sessions are germane. Foremost it is necessary to dispel the notion that the company planned carefully. Such was not the case. Apparently it is "the other company" that is well organized and plans. "We could foul up the Last Supper" was the way one corporate vice president of a major Fortune 500 aerospace company put it. And, even if there is some plan, the implementation and subsequent follow-up is most difficult due to the myriad of product and organizational changes. Company X was so uncertain about the program requirements and its other programs that detailed plans were not feasible. As noted above, shortly after the contract was awarded an avalanche of customer initiated changes ensued. The problems of funding the work, of getting vendor drawings changed, of obtaining clarification on the changes and of obtaining contractual authorization rendered any previous planning null and void.

The initial intent was to make a profit on the contract. It was recognized by both parties that the target for the FPI was to be around the ten or eleven percent mark. Price ceilings for FPI contracts were traditionally twenty to twenty-five percent. Due to the development nature of the contract and the need to have a fixed price type contract (the Slay years) an unusually high ceiling of 30 percent was negotiated. A share ratio of 70/30 was imposed by the government. But once the contract was negotiated and commitments made for the following fiscal year, much of the opportunity for any significant cost reduction was lost. Given the climate of the estimate (the competition and the

⁹ Ibid. Section VIII. See particularly Section 12 of original NASA Incentive Contract Guide on extra-contractual motivators.

three best and finals) there was never any possibility for the contract to be underrun. The only question was if a loss could be averted or if the contract could be brought in close to the ten or fifteen percent over target. Since some sixty percent of the value of the contract was either in material or subcontracted parts, the probability for reductions were even further reduced. But one feature particularly stood out; the budgets and the lead times. The very fact that the program was planned at a certain level of manpower and materials made it almost impossible to reduce the costs. Clearly the probability of underrun and overrun is not equal. Everything in the contractor-government acquisition system drove the costs to target or over. In fact, it was very difficult to find out the exact costs incurred; this was due to the uncertainty of the allocable overhead and general and administrative expenses. Another problem was changes.

Changes started to be imposed by the government shortly after award.¹⁰ They were made on a not to exceed basis. As the changes accumulated some were definitized as part of the incentive, some were not. In retrospect it was virtually impossible to compare the original intent with the outcomes. On the surface the target costs ended up about nine percent over the target. The final fee was 10 percent: This was close to that originally targeted (11 percent). But the real profit was a lot less. The company's cost of capital went from eight percent to nineteen percent. Because the company was in a rapid growth situation and because it attempted to grow from internally generated funds, the company was forced to absorb the higher rates of interest. Unlike its commercial segment, it was not feasible to pass on the increased cost of operating capital to Uncle Sam. The net result was that the company at best

¹⁰ There are several excellent discussions of the changes problem in Section VI. See particularly 52 by Redden, Lt. Edward G. and 56, the Booz-Ailen study.

broke even. What did it gain? Well, it obtained technical advantages over its competitors and it enhanced its reputation with the government. The question that must be addressed is whether the incentive contract had anything to do with these outcomes. It is not possible at this time to ascertain with certainty the answer to this intriguing query. However, it is possible to gain some insight. One tempting scenario is that the changes added to the contract first as part of the incentive and later as fixed price portions permitted the parties to handle the uncertainties as they occurred. The government and the contractor worked together in an informal fashion. This was accomplished through a flexible contract that permitted adjustments to the problems as they arose. This resulted in the illusion that the original target was valid. And perhaps it was -- for the work originally defined. But more likely the changes absorbed the additional costs that the contractor incurred.¹¹ The final costs appear more a function of the cost of goods sold and the G & A rate during the performance than the particular incentive provisions of the contract. It is more a function of program definition, definitive specifications, and timely interaction than the type of contract. For success or failure the government can be judged as an accomplice to the act. Also the need to buy on the edge of technology (real or apparent) affects the outcomes more than the contract type. The competitive environment and the economic environment are also significant.¹² Perhaps to approach the question differently, given certain kinds or levels of the relevant variables, what should the nature of the contract type be, and more importantly, what should be the nature of the buyer-seller relationship? It appears to require a team effort.

¹¹ See particularly, Redden (52), Fisher (58), Cross (59), Hill (61) and Berhold (65).

¹² Ibid.

The Contractual Period of Performance¹³

The initial incentive contract was scheduled for completion in two years. The entire development and production was to have spanned six years. After the first several months, the original intent of the contract began to change as the parties were faced with certain realities of the weapons game. How are we to accomplish a vital change when funds are not yet available? "Do it on your own, and we will get even on the next option." A new design looks promising. "Can you study the feasibility of the design under the current contract vehicle so that we do not have to compete it and lose a couple of years?" "Headquarters has decided not to rehab these units in the field. If you need them for the performance of the contract you will have to figure out how to do it yourself." The list is endless. Aberrations of the contract intent came up weekly -- not monthly. Therefore, the longer the period of performance the greater is the likelihood that the initial intent of the contracting parties will be lost. This is not through any overt action of the parties, but merely through the attrition of change; change of people, change of program, and change of problems.

Another factor associated with time arose. The company tended to budget for periods of six, twelve or eighteen months. After the functional managers and program managers submitted budget estimates, they made sure they spent every dollar they got. Nobody ever gives money back. There is a built-in bias to spend what you plan to spend.¹⁴ Also many managers asked for more than they needed to begin with in order to protect themselves against eventualities

¹³ Ibid.

¹⁴ There were several large samples of contracts studied. See Section VI of Volume Three study. See particularly Hill (61), Berhold (65), LMI (67), Jones (70).

that always somehow materialized. Thus, the question; "does the company management have the flexibility to reduce costs substantially?" "What happens to my next year's request if I do get lucky and come in significantly under cost? More than likely, my next estimate will be discounted? Am I better off or not." The mentality of the management is not to underrun or overrun significantly. This in part seems to be a function of whether the manager in question initiated the estimate or whether he had taken it over from another manager. Of the many points made, one assumption must certainly be questioned. Do managers really have the flexibility to reduce costs that have been in the budget stage for perhaps over 18 months. The answer is probably no!

The Government's Contract Administration Process¹⁵

What is the impact of the government's contract administration? What are some examples of the problem? Many were observed. Everything takes longer than expected. Agreements reached at one point in time have to be re-explained to the new contracting officer or auditor. Commitments made early in the program were reversed in latter stages. Coercement by well-meaning government employees, feeling the oats of power, were rare but visible. The inability to find one single individual to bind the government without the threat of reversal by the DCAS or DCAA was evident. The significance of personal whims was paramount. "If they like you, O.K., but heaven help you if they are out to get you." The influence of one man in the process, who for whatever reason decides that you are not a competent producer can be devastating to future business. The higher the rank or the position of the antagonist, the more damaging can be the assessment. But even the low man on the totem pole can

¹⁵ Section I and II of Phase I study provides some insight into this process. The Senate and Congressional hearings of the DOD appropriation hearings is also an excellent source.

hurt. This is not that much different from commercial practice. The uniqueness of the problem is that in the commercial world there are usually other buyers. So it is business as usual to lay the red rug out for the visiting firemen. Smile and be kind; be, in fact, ingratiating. Do not make the buyer mad. To the extent that this is a universal problem is questionable. Whether it is more a problem in aerospace-government relationships than in commercial practice is worth studying. It definitely was part of the life of this aerospace contractor.

Three other aspects deserve note. First, the government teams are constantly in evidence in the plant. If they are not visiting for some purpose they are planning to visit. Enormous amounts of energy, talent and time must be invested in making the visitors happy. In most instances the visitors want to see the top management including the president of the company. Secondly, too much documentation appears to be required for the administration of the incentive type contract (indeed perhaps any type). Does the cost of the administration and the delays and perfunctory presentations and data accumulations cost more than any incentive contract could help to save? Are not penalties that could be made available adequate to assure contract compliance? Finally, the threat of unallowable, unallocable or unreasonable costs hang over the head of the incentive from the beginning.¹⁶

Organizational Problems that Affected the Incentive

Several aspects of organizational problems were studied: structure, stability, authority and responsibility, management of growth, and management of control. Over the period of the study the company's sales increased dramatically.

¹⁶ See Redden, E. G., Lt. Comd., The Use of Incentive Contracts in Aircraft Procurement (52). He has a provocative discussion of the importance of minimum administration.

The number of employees increased by a factor of four in the first two years and then leveled off. In terms of the product life cycle, the company was in the stages of rapid growth. Many of the features of the organization that were observed are fairly representative of such a growth company. Our interest is the impact that this had on the incentive contract.

Structure

Initially the company used a standard line-staff organization. The dominant functions were engineering and manufacturing. The functions of marketing and finance were understaffed and unsophisticated. The management of the firm was in the hands primarily of technically trained engineers. With the growth of the sales and through the pressure of the customer the company shifted to a matrix type management structure. At the time of its adaptation the number of employees approached 250. The adaptation led to confusion. The old informal organization was disrupted. The heretofore reasonable satisfactory financial system had to be scrapped and a new one installed. To handle the complexity of the matrix organization and the related requirements of CSSR a computer was purchased. In this period of growth there were no less than fourteen reorganizations. There were sixteen changes in the ranks of top management. There have been four vice presidents of finance. More to the point, even the clerk that processes the DD250's has been changed six times.

The matrix management system did not function well.¹⁷ Eventually much of the early matrix approach was dropped due to the problems of excessive costs, lack of control and communication problems. The contracts group was always small. The program managers were responsible for managing the programs but had

¹⁷ Much of the impetus for matrix management came from the Monterey Conference and the original nine month "SPO" course developed by Col. T. Cummins and Prof. John J. Kennedy for Gen. B.A. Schriever at the school of systems and logistics in 1960. See course material.

little familiarity with contracts. The budgets were established prior to the negotiation of the contracts, revised after final negotiation and then controlled by the program managers. Because of the limitations of the accounting system program managers were only able to control direct labor. Burdens were allocated by the estimating and financial group. The targets of the incentive were incorporated in the original budgets but the changes modified the original intent of the parties. Few if any of the new members of the organization understood or knew of the original goals.¹⁸ Nor did they care about the old problems. They cared about what would reflect back of themselves. The emphasis was on the technical aspects of the contract. The product had to work properly. Schedule was second, cost was third. The contract type seemed to receive little consideration except when the type was straight cost.

Stability

It is questionable if an incentive can function in an atmosphere of severe organizational instability.¹⁹ As noted in this case the organizational structure was in a state of constant change. There was little if any corporate memory. Each new assignee to a job had to rediscover the wheel. What is this backlog of DD250's about? Do we really owe this vendor this much? What is the meaning of this clause in the contract with vendor ABS? Nobody knows! The original intent, though previously documented had been lost. Multiply this several times and you get some idea of the difficulty of instability. And it is not just the company. The government gets confused too. As members of the government's team changed (and they do . . . three contracting officers on one

¹⁸ The study of Hill and Shepard found no evidence of organizational delegation of incentive parameters. See Hill, W. and Shepard P., Effectiveness of Incentive Contracts as Motivators (90).

¹⁹ Hunt, Raymond, The Use of Incentives in R & D Contracting: A Critical Evaluation of Theory and Method. (52).

program in three years) they too had to rediscover the wheel. And too often the wheel came out with a different design. All agreements made with the contracting officer were not written. And those written had a particular intent based on the understanding of the contracting parties. Often when someone new reviewed the documents, something was read into or left out of the document. The result often was some unfair action. In the case at hand, the first contracting officer reviewed a million dollar charge and found it reasonable and allocable. Two years later when the auditor questioned this same charge, the new contracting officer sided with the auditor. The original contracting officer, still with the government but promoted to a different spot, had to be contacted to clarify the situation. This is merely one example of the uncertainty the contractor is confronted with as regards the commitments of the government. The more unstable the organization of the buying officer the more aggravated is the problem. In short, stability is an important factor when considering an incentive contract. The more complex the incentive and the longer the time period of performance the more important is this factor.

Authority and Responsibility

The matrix management approach for this growth company was inappropriate. It resulted in poor accountability. The more controversial the issues the greater the probability that someone would let somebody else take the blame. The responsibility for the incentive was given to a consultant who was hired primarily as an accountant and as an estimator. Since he did not work with contracts or finance and since he did not have much contact with the CEO his valid concerns went unheard. Due to the type of accounting system used, there was little or no control responsibility. Where was the control? It rested with the chief executive who as a scientist and engineer had little appreciation for finance and less for incentive contracts. He was, however, concerned with

performance and profits. Budgeted costs were periodically reviewed by the CEO in weekly staff meetings. However, since real time data was not available, overly optimistic data was often provided by his staff. This phenomenon was particularly bad since the CEO had a habit of berating and criticizing those who were the bearers of bad news.

The financial vice president prepared and distributed cost to completions for the major contracts. Efforts were made to keep the major executives abreast of the progress. But generally the financial information as it existed was the privy of the CEO; little was shared with middle management. Since individual program managers could not control overhead and G & A allocations, they were at a major disadvantage in controlling the total costs incurred. There simply was not any organizational program established to track tradeoffs or related considerations on the incentive. In the opinion of the Vice President of Finance, the incentive had little to do with the contract outcomes. More about this later.

Management of Growth

The management problems of growth are well documented in the literature. These include a thin management experience base as new people are brought on board; the increased difficulty of communication, the inability to find out costs, decisions based primarily on seat-of-the-pants management, a severe shortage of cash and the need for equity capital. This company experienced all of these diseases. The problem was they were unaware that the blessings of growth have the potential for failure. There was little evidence of any formal management of growth, and they attempted to handle the problems as they arose from their prior experiences. Needless to say, in this situation the contractual incentives lost their intended attractiveness.

Control

A not uncommon problem of corporations is that they view the control

function primarily as an after-the-fact phenomenon. Often it is then too late. It is necessary to have leading indicators that are predictors of the variables that are to be controlled, so that in a real time fashion corrections can be made when deviations are detected. Traditional accounting systems do not provide this kind of data. Unfortunately a traditional system is all the company had. The accounting system and the financial management tools provided macro, after-the-fact data. These aggregates depended heavily on judgments for allocations of fixed costs and related overhead items. No true picture could be obtained on what was actually spent to date. Since an adequate system did not exist, it can be stated that the management of the incentive was at best crude. Reactions to major problems took several months since it required that time to sort out the source of the problem, its impact, and probable causes. One cannot help but wonder how many companies fit this pattern! To the extent that they do, the Department of Defense needs to rethink the use of incentives.

The Organizational Behavior

How then do companies react to incentives? What priorities do companies place on cost, schedule and performance factors? If a cost overrun is eminent, which is slipped first? What is the relationship between negotiation goals and the decision to slip one of the variables? How do companies behave? This problem can best be assessed in the context of the nature of the product and the competitive environment. After a brief description on these factors several behavioral traits are reviewed.

The product was a complex mechanical device that was designed to operate at very high speeds under hazardous conditions. It weighed several thousand pounds and was priced at sixty thousand dollars per copy. It was to be the first generation model. The function that it was to serve had previously been done by hand. Several large companies had been unsuccessful in developing the product; the

specification was based on state of the art technology, and the total contract dollars were estimated to exceed sixty million over a five-year period. The system had several component parts. Eventually the component parts could be, if the government desired, contracted for separately. As noted earlier, one of the goals of the company was to keep all the components under a system umbrella and to hopefully prevent the government from someday competing them.

The product was innovative; several companies were working on its development. Initially the competition included two large billion dollar corporations, several medium size companies and one other small business. The market was very narrow. There was apparently only one buyer for the foreseeable future. Probably the sister services might have requirements when and if the system proved successful. There was also the potential of foreign sales if the state department concurred. But at the time of the bid the large sixty million dollar contract was the sole demand for the product.

The keys to motivated behavior are the needs of the individuals and groups. For incentive contracts to work, it is paramount to assess what the company really wants. In this case a key motivator was technical achievement. The product had not been made before. First and foremost the feasibility of the concept had to be demonstrated beyond any reasonable doubt. The company had an eye cast toward future business. There were no other buyers for the product. But can one invest in plant and equipment and the training of personnel only to find that one has a capability but no market? Obviously not, so follow-on business was another of the critical drivers of behavior. In this context the contract that was negotiated makes more sense. It would permit an overrun of thirty percent without a loss! The company would earn some profit up to the

²⁰ For a very interesting discussion of contractor behavior see Oppendahl, P., Understanding Contractor Motivation and Contract Incentives (95).

contract price ceiling. Not a bad deal! The company wanted protection plus the opportunity to invest in technology to protect its market edge. In the commercial sector the edge is often gained through getting in the market place first and building volume. The advantage of volume is that the cost per unit goes down through learning. Hopefully it can be reduced to a point where no one can compete. In the aerospace market perhaps companies overrun to invest in development. They do so simply because they cannot afford to provide the funds for development out of earnings or private capital. For Company X the contract price ceiling provided the opportunity to overrun costs (invest in R & D) by fifteen million dollars. Little wonder that there is a built-in drive to spend to target or overrun.

In summary, the company slipped cost first, schedule second (easy since changes are always being imposed) and performance last. The company in several observed instances incurred overruns to assure technical supremacy.

The Personalities of the Principals

Corporations have personalities which are often inherited from its founders. These personalities affect management decisions and style. During the period of this research it became increasingly clear that the attitudes of the executives toward the government played a major role in the corporate actions. Similarly the attitudes of the government representatives toward the company affected contract outcomes. It is not within the scope of this paper to explore all the obvious implications, but several points are worthy of note in the event that subsequent research is undertaken.

Much of the nature of high technology resembles decision making under uncertainty; under uncertainty risks cannot be accurately assessed.²¹ In situations

²¹Section IX of Phase I report summarizes literature on risk and incentives. See particularly 9.8, 9.22 and 9.23 which deal with assessment of risk under uncertainty.

of uncertainty personalities and related attitudes play an important if not the dominant role in determining outcomes. For example, is the individual a pessimist or an optimist? Is he used to winning or losing? In the absence of hard data these expectation sets of previous experiences are often dominant in the decision process. In Company X the principal owned all of the stock. His track record was one of steady rapid success since the early fifties. He was a multi-millionaire. He thought he could not lose. He had taken chances in the past and had won. He was an aggressive optimist and ran the company in that vein. This was reflected in his attitude toward the incentive contract. All would go well. Solve the technical problems and deliver the product. Details are not important. It is the big picture that counts. Take care of the big things and the little things take care of themselves. The contract is the paperwork side of the house. It is really not important if you just do your job right. The contract is to protect the parties if something goes wrong. Full speed ahead and damn the torpedoes. In this atmosphere detailed financial analysis and data similar to CSSR were viewed as a contractual nuisance. The contractual complexities of government work were required but unnecessary and unfortunate. In a sense it was all funny money. The real business was the business of design and delivery of a sound product on time. The founder and chairman of the board selected a chief executive officer (scientist) and senior staff that shared this view.

General Conclusions

This pilot study provided a unique opportunity to study how corporations behave under incentive contracts. General conclusions are presented on the accounting and financial systems, the government environment, the negotiation process, goals and outcomes, the performance period, the government administrative process, organizational problems, performance factors, product nature, the

competitive environment, the behavior of the company, and personality considerations.

Accounting and Financial Systems

1. The accounting system of the company was not adequate to provide the data necessary to manage the incentive.
2. The modification of the accounting system to comply with the CSSR requirements led to more, not less confusion.
3. The company was not confident of its own cost estimates.
4. Because of the constant turnover and change brought on by rapid growth and the need to comply (or desire to comply) to the way the government does business, the first level accounting and financial clerks did not understand what they were doing. The system was flawed at its roots.
5. Arguments constantly arose over appropriate overhead rates to apply to the various product groups.
6. Accounting and financial data was provided much too late and in the wrong format for timely decision making.

In summary the accounting and financial management systems did not provide the basis for the effective management of the incentive contract.

The Government Environment

1. The attitude was paternalistic.
2. The atmosphere varied with the various government offices. The buyer's attitude was different than that of the auditors.
3. The SPO required covertly that the contractor perform work outside the scope of the contract "in the interest of the program and both parties."
4. Career aspirations of key government officials were often linked to the success of the program. Hence, a team effort and an atmosphere of cooperation developed between the contractor and the system program office.

5. In several instances the government team "worked the system" to achieve the desired ends when it was of mutual interest to do so.
6. In doing business with the government the contractor is dealing with a myriad of offices and personalities. No one single individual seems to be able to commit the government. The decision making process was so diluted that the contractor was often confused as to who should direct his efforts. Who should they respond to?
7. There is a high level of uncertainty concerning program funding and implementation. The contractor was in a state of constant anxiety about the government's probable funding actions.
8. Often, partly as a result of the above, the contractor's major concern was survival through the minimization of risk. Thus, he was not attempting to maximize profits as is assumed in the incentive contract philosophy.

The Negotiation Process²²

1. The primary goal seemed to be a reasonable profit at a minimum risk consistent with assuring future business.
2. The incentive contract should not have been a fixed price type in the early stages of the procurement. It is probable that the contract type was influenced primarily by the "Slay" initiatives.
3. The contract with its high ceiling and modest slope was in essence a type of cost plus incentive fee contract. It was a recognition by the parties of the uncertainties of buying development.
4. Given the three best-and-finals and the keen interest in the procurement by several contractors, there was little probability of an underrun.

²² See Section VIII of Volume III report on Motivation. See particularly (113) (114) and (119).

The key concern should have been the probability of an overrun.

5. Best-and-finals probably are counter-productive to the use of incentives. In fact best-and-finals reduce the possibility of substantial underruns. Surely, the patterns that emerge after the best-and-finals are highly skewed toward overrun. In that environment contractors are not looking at the possibility of sizeable profits through underrun. Rather, the protection of the ceiling is what matters. The contract worked, but it achieved a different goal than intended. It permitted the contractor to bid low with the knowledge that he could incur costs up to the ceiling of 130 percent of target cost. The relationship between best-and-final and the structure of the incentive needs to be studied further.²³
6. An adversarial atmosphere dominated the negotiation sessions. An implication that contractors are dishonest hovered at times over the meetings.

Goals and Outcomes²⁴

1. The contract type had little to do with the outcomes of the contract.
2. The contract type provided the contractor with the opportunity to accept a fixed price type contract in a cost type environment.
3. There was no attempt or capacity on the part of the contractor to monitor the incentive. The company knew it had to end up somewhere around ten to thirty percent over the target cost. The final cost was to be determined in the minds of the company by unforeseen events.
4. The bottom line of the financial statement will probably be a loss for the contractor. The final estimated costs now appear to be about 12% over

²³ See Baron, D., Incentive Contract and Competitive Bidding (136) and also Evans, J., Potential Adverse Effects of Competitive Prototype Validation (93).

²⁴ See Section VIII of Volume III; also Hunt, R., et al., Federal Procurement: A Study of Some Pertinent Properties, Policies and Practices of a Group of Business Organizations (117) See also Section 12 of original NASA guide (21).

target cost. When disallowances and the increased cost of capital are considered the company will be lucky to break even.

5. The final costs are almost impossible to determine. This is due to the changes that were added as fixed price add-ons and not to exceeds.
6. The contractor was able through the contract to develop a leading technological position for follow up business.
7. Contractor motivation for profit might well be demeaned by the recognized profit ceilings inherent in doing business with the government. Administered profit ceilings are common for each contract type. Both parties going in recognize these limitations. If a contractor knows that the government is going to limit his profit, say to ten percent, what does he do? Perhaps he targets for that fee and shifts his goals to other more attainable outcomes.
8. Everything about the government-industry relationship drives the costs toward an overrun and not an underrun. This will be explored in the final report.
9. Changes seem to be part of the government contractual life. As soon as the contract was signed changes started. The effect of the changes was to substantially alter the original intent of the incentive.
10. Several variables emerged as more dominant than the contract type. These were: follow-on potential, the economic environment, the contract mix in house, the loss of another major piece of business, and the desire to diversify out of the primary product area.²⁵

²⁵ Ibid. This observation on multiple extra-contractual motivators dominating contractor behavior appeared regularly in the literature of the last twenty years.

The Contractual Period of Performance

1. The longer the time span the more the likelihood that the original intent will be lost due to changes.
2. The budget cycle affects the company's ability to reduce costs. If cost bogeys have already been delegated to company departments and divisions, it is quite probable that these funds will be committed and spent. Nobody gives money back.
3. Company personnel do not have the flexibility to reduce costs substantially. The potential for such cost reductions are not there.
4. The longer the period of performance the greater the difficulty of managing the incentive.

The Government Administrative Process

1. Everything takes longer than expected.
2. Coersion by well meaning government employees, though rare, was in evidence.
3. It is difficult to obtain an answer in a short time from any government official.
4. The authority of individuals in key areas of influence is almost absolute.
5. Government audit and administrative personnel like to throw their weight around when visiting the plants. This occurred frequently enough to be noted.
6. Government teams are constantly in evidence at the plants. If they are not visiting, they are planning to do so.
7. There is an enormous data burden that probably is not worth its cost.
8. The threat of disallowances and the attitude about "excessive" profits deters the potential increased profit of the incentive.
9. In light of the above the administrative process of checks and counter checks often discourages and destroys the potential of motivation of the

incentive contract.²⁶

Organizational Problems that Affected the Incentive

1. The matrix organization as employed was detrimental to the incentive. Nobody knew what was going on.
2. The constant organizational flux due to growth and normal attrition made it very difficult for anyone to track the incentive. There was very little organizational memory. At the end of the contractual time period few in the organization had any idea of its origins and the related intents.
3. The problems associated with growth such as loss of cost controls and the breakdown of communication impeded the effectiveness of the incentive.
4. It is highly questionable if an incentive can function in an atmosphere of rapid growth such as was witnessed in this company.
5. The turnover in the government jobs also hindered the incentive. For example, agreements made by the first contracting officers (in writing) were subsequently misconstrued by the second.
6. The more complex the incentive and the longer the performance period the more important is the stability factor.
7. Rapid growth often results in inadequate management capabilities, loss of control of costs, poor communication and a euphoria of optimism.
8. In addition, rapid growth companies are often cash poor, particularly if they are undercapitalized. In these situations, and of course when the cost of money skyrockets, the emphasis is on cash flow.
9. The incentive contract was not written for a growth situation.

²⁶ All of Hunt's work is applicable. See also Runkle, J. and Schmidt, G., An Analysis of Government/Contractor Interaction as a Motivator of Contractor Performance (108).

The Organizational Behavior²⁷

1. Performance was the last variable to be slipped. Cost was first, schedule was second and performance was third.
2. The market was very narrow and the major motivation was to secure follow-on business and technical superiority.
3. The incentive contract did not reflect the above.
4. The company first wanted to make the product work.²⁸
5. Follow-or business was a critical factor.
6. The company wanted to maximize dollars for development.
7. There was a built-in drive to overrun. The impetus came from the competitive environment, the narrow market (no one else to sell product to), the awareness of the changes opportunity, the fixed nature of the planning budgets and process, the human element of spending every dollar one obtains in budget allocations and the problems of justifying high profits in the event of an underrun.
8. The expectation sets formed by previous experiences are often dominant in decision processes associated with uncertainty.
9. Companies reflect the personalities of their owners and founders. In this case these were scientists and engineers. Therein lay their principle interests.

Personalities of the Principals

1. Corporations, like individuals, have personalities. Included is an attitude toward the business side of the enterprise. To some the contract is merely unimportant paperwork. What was important to the scientist owner

²⁷For different points of view see Cross, John, Reappraisal of Cost Incentives on Defense Contracts (59); Deavers, K. L. and Mc Call, J. J., Notes on Incentive Contracts (58) and Fisher, Irving, Cost Incentives and Contract Outcomes (58), and NASA's Summary of Booz -Allen Study (56).

²⁸See Section VIII of Phase I report. The Booz - Allen study for NASA (56) and Oppedahl work (95) are good starting points.

was the hardware and getting the job done. This attitude toward the contract was hardly conducive to the incentive.

2. In this kind of environment CSSR and related requirements were viewed as nuisances at best and trivia at worst.

Insights on the Hypotheses

There were, as the reader will recall, fourteen hypothesis established through Phase I. Each of these was studied in the pilot analyses. In this Phase II report these are evaluated in light of the pilot case findings. In the Phase III report these results will be compared to those from the questionnaire and related interviews.

Each of the original hypothesis and the reflections of the pilot study are presented in this Part Four. Some redundancy from the prior comments will be apparent. The conclusions are intentionally kept brief. A full development of these ideas will be presented in the final report.

1. The Type of Contract is not the Determining Variable in Influencing Corporate Behavior.²⁹

There is no question that the dominant variable affecting this contractor's behavior was not the contract type. The contract type was influential in establishing the upper levels of expenditures and the extent of the government administrative responsibilities. But the decisions that determined the outcomes of the contract were made with little regard for the fixed price incentive.

2. Most Incentive Contracts End up Near Target³⁰

This contract was negotiated to permit an overrun of at least thirty percent without loss. In fact, it appears that the final cost will be about 12% over target. But this could be very misleading. Too many changes obscure the

²⁹ See Volume I.

³⁰ See Volume I.

real costs. Shifts in accounting systems and perhaps cost categories distort reality. This could be why these contracts can end up near target. The procurement system permits manipulation; appearances of final costs near target can be fallacious.

3. The Target Cost of Incentives is Higher than Targets of Alternative Contract Types

Only limited insight can be gained on this issue. However, in the planning for the incentive when a cost versus an incentive was considered a higher planning target was proposed for the incentive than for the cost. For a higher risk a higher target.

4. The Most Significant Factor in Determining the Target Cost for Negotiation is Where you Expect to End Up³¹

The company set the price ceiling at the estimated pessimistic final cost. They did so to optimize protection. If they could have, they would have set the target cost higher. The best-and-finals and the dollars available in the budget as revealed by the contracting officer changed that. The contractor sought as high a target as feasible. In reality, the competition and best-and-finals forced them to accept an unrealistically low target. To offset this, they negotiated a high ceiling of 130% for the FPI.

5. In Many Instances the Government in the Administration of the Incentive Destroys any Opportunities for the Incentive to Work³²

Is the major culprit the government administrative process or the buying on the edge of technology? Or both? No doubt the administrative process hurts.

³¹Ibid. See also Hill, W. (61) and of note, Mc Call, J., An Analysis of Military Procurement Policies (143).

³²See (52), (54), (58), (76), (82), (90), (95), and (116). There has been no major study of this relationship, but several studies hint at the problem.

But how much? Probably a lot. The response times, the lengthy decision processes, the uncertainty of government commitments, the distrust reflected in the procurement process, the attitude toward profit all play a role. When all is said and done the government really does not want industry to make high (say over 12 percent) profits. What does the government want? The answer might be programs that cost what Congress is told they are to cost and profit levels that seem consistent with traditional economic theory (in a truly competitive industry profit levels are modest).

6. The Cost of Administering an Incentive may Outweigh any Savings that Might be Achieved Through the Contract Arrangement³³

It was not feasible to address this directly in the pilot study. But one was able to gain some insight into the problem. Fundamentally the government attempts to keep the contractor honest. More to the point, did the contract have any potential for major cost reduction? The answer is no. An incentive to motivate must be clear, achievable and the reward timely. This criteria is seldom met.

7. Many of the Contractual Arrangements are Designed for Intentional Overruns³⁴

This contract was designed by the company to minimize risk. The government needed a fixed price contract type due to the Slay initiatives. When viewed in that context it satisfied the aims of both parties. To the extent that the company expected to end up about ten to twenty percent over the target cost the hypothesis is valid. The company felt that the costs were tight particularly after three best and finals.

³³ Ibid. See also Hill, W., Observations on Incentive Controls (61).

³⁴ See Redden, Edward G., The Use of Incentive Contracts in Aircraft Procurement, (52) Hill, Walter, Observations on Incentive Contracts (61).

8. Many Incentive Contracts are Inappropriately Structured, What Started out as Rules of Thumb Have Become Biblical³⁵

In this case the contract was probably appropriately structured. What eluded the government was what was actually motivating the company. As noted earlier the drivers were other than short-run profit. If the intent was cost control and the achievement of the technological goals, the contract was eminently successful (if the costs are valid). It simply was not a typical incentive. It was a cost control contract.

9. Penalties are Better Motivators than Rewards³⁶

The basic concern of the company was the price ceiling. It did not want to lose money. It wanted to optimize development goals within the dollars available. It optimized dollars, not profit. In that sense the penalty of the incentive price ceiling was much more effective than the opportunity for profits. The penalty approach needs some thoughtful reconsideration.

10. The more Complex the Arrangement of the Incentive the More Likely it will be Ignored³⁷

This was a simple incentive and it was ignored. If the incentive was a multiple with several performance and schedule parameters there would have been little hope that the company could have managed it. The most important element in the incentive was the performance element. Contractors will readily slip cost and schedule goals to meet the performance goals. Incentives have to be simple to have any chance of working.

³⁵ Jones, W., Experiences in Incentive Contracting (81). This is a good summary of common deficiencies. See also Booz-Allen NASA study (56).

³⁶ See Parker, John H., An Examination of Recent Defense Contract Outcomes in the Incentive Environment (82). See also LMI, An Examination of the Foundations of Incentive Contracting (74).

³⁷ Ibid. Also Jones, W., Experiences in Incentive Contracting (81).

11. Incentives have to have Organizational Visibility to Work³⁸

Since there was no structure organizationally for the incentive and since it was not overtly managed this hypothesis is valid. But this is said with tongue in cheek. Given the circumstances, it is doubtful even if an organizational entity had been held responsible for the incentive, that the outcomes would have been any different. Events outside the contract were the determining variables. Certainly the company could have been more aware of the status; but, it is doubtful since there was not an adequate information system to provide the necessary basis for analysis and action.

Neither Hypothesis 13 or 14 are covered in the pilot study since both had to do with cost type contracts.

It is informative to compare the results of Company X which is a relatively small company with Company Y which is a composite of larger corporations. The reader will note that many of the deficiencies noted for X are applicable to Y. Additional size and the conditions that come with it do not seem to alter the outcomes.

³⁸ Much of Hunt's work has been on this point. Hence his interest on Award Fee. See for example Hunt, R. et al., Factors that Influence Organizational Performance (119). See also Redden, Edward G., (52), Booz-Allen (56).

COMPANY Y

Description of Company

Case Y differs from Case X in that it represents a composite of several companies. Case X dealt with a privately held, medium small prime contractor; Case Y deals with a composite of several large prime aerospace companies. The particular units were usually major divisions of corporate conglomerates. The number of employees exceeded 700 and the value of the contracts were in excess of two-hundred million dollars. Each firm had a separate contracts group. The responsibility for pricing varied but generally was separate from the contracts group and was centered in the financial and/or controllers' department. The companies were well represented in Washington, had extensive field representative activities, operated on a variety of program management formats and were dominated primarily by executives with technical backgrounds. Another characteristic was the presence of retired military personnel. The conglomerates had a mix of military and government business but the dominant thrust was aerospace. The technical products of the consumer sector were closely linked to the aerospace products. The companies were old line companies that had been in the aerospace business for the last twenty years or longer in some capacity.

Type of Contracts Studied

The particular contracts type varied by firm. A typical contract was selected for purposes of illustration. This was a multiple incentive; fifty percent of the fee pool was allocated to cost and 50 percent was split between schedule and performance. The schedule pool was allocated to four parameters and the technical pool to six parameters. The contract type was a CPIF with a cost swing of plus and minus twenty and thirty percent respectively. The maximum fee was 15 percent; the minimum was two percent. The first phase of the procurement used a cost type contract for the initial development. The

second stage was a multiple incentive as described above. The typical company visited did not have a specific incentive contract team. Rather they had a residual of experience built up over the years. Often the dominant experience was at the senior staff level. Many of the younger employees had little knowledge or training in incentives. Often there was a rather glib attitude to the inquiries. This in itself had a message for the researcher.

Competitive Environment³⁹

The competition varied by product line. For the contract in question, it was generally very narrow. It consisted of three major competitors. The manufacturers of the product were well known and recognized producers. In the long run the market had several buyers. In the short run only one. The contracts were awarded after an extensive source selection process. The proposal effort was expensive. Risks were high. For the loser the result might well have been oblivion. There was therefore considerable pressure on price. Although the award process was not on price alone, it often played a dominant role. The contract type was specified in the request for bid and contractors were encouraged to respond in the format indicated. There was to be a fly-off. This combined with the best and final resulted in considerable downward pressure on original cost estimates and the final bid.

About fifty percent of the value of the contract was subcontracted. The system has nine major components, four were made by subcontractors. The make or buy strategy of the company varied with the general economic conditions. In boom times the procurement personnel were working overtime to commit funds. At such times the goal was to get somebody on contract. The early part of the program was hectic. The government "wanted the product yesterday." There was

³⁹ See Section V. See particularly (34), (43), (46) and bottom of (47).

not adequate time for planning. Another aspect of the subcontract process was the need to meet the requirement for the use of small and particularly minority businesses. The minority business chairman worked feverishly to locate competent producers. Subsequently these very producers caused serious problems due to the inability of the products to meet the standards of the first article tests.

After receiving the CPIF multiple, to the extent that it could, the prime "farmed out" large portions of the work on a fixed price basis. It thereby reduced substantially the uncertainties and perhaps the risks of overrun. This problem needs further study. Corporations that are capital intensive and subcontract out large percentages of their contract dollars have little or no control over further cost reductions. What then is the purpose of the incentive?

Company Organization⁴⁰

The company was organized functionally. Major projects had program managers. These directors, usually with technical backgrounds, coordinated the functional areas of the company to support their system. Upon award of the contract the program management group grew rapidly. It worked closely with the government system program office. The responsibility for the contract was in the directorate of material under a vice president of contracts. Once a contract was in-house it was administered by the contracts group. But the program manager was responsible to make sure the product was produced on time and that it worked. He was also responsible for the budgeted costs. On the other hand, changes, modifications and the myriad of other details were handled by the contracts group. Each part of the contractor's team interfaced with its counterpart on the government's team (SPO). Functional specialization was the rule rather

⁴⁰See Kennedy, John, Defense Aerospace Marketing: A Model for Effective Action (42).

than the exception. Surprisingly there was no organizational unit for tracking incentives. Costs were provided to all key executives by the financial and computer group. This function was under the controller.

Accounting and Financial Systems⁴¹

There was not time or resources to evaluate the financial systems in detail. Suffice to say that complex, computerized systems existed that provided cost data on about any format one wanted if adequate time was provided for its preparation. Data was provided through remote videos in a variety of forms. On the surface it appeared that the data was available to manage the program. However, difficulties arose from the complexities of the situation. By the time the program was in-house and the data base operational, many things had changed. Certainly the technology existed to provide a management information system to support a complex system. But if the product is in a constant state of flux and if the variables related to the system are random, non-linear, and multitudinous, the situation becomes hopeless. If this observation is valid there are serious doubts whether any company can track and manage a complex multiple incentive. For the cases in question the information systems provided crude overviews. But there was not a single case studied where a contractor attempted to manage the incentive to obtain a significant underrun. No one seemed to be able to get "a handle" or "get their arms around the problem." Or perhaps there was no intent to begin with. The companies studied worked on six, twelve and eighteen months operating budgets that were primarily geared to a reasonable return and to maintain the fixed overhead of the business. These budgets were tied to equipment and manpower loadings that were not subject to short run manipulation or reduction. Managers were evaluated on cash flow.

⁴¹ Moore, William F. and Cozzolino, John, More Effective Cost Incentives Through Risk Reduction (139).

In many instances the only action a manager could take was to dig in his heels, hang on, and hope that the costs would stay reasonable. There were too many components and too many factors outside his control.⁴² What he saw was only his part of the program, his budget and his needs to generate cash flow. There was no incentive to reduce costs. Quite the contrary. He spent all his funds to assure getting the job done and the higher the cost incurrence the higher the cash flow through progress payments. Even more frustrating was the individuals' inability to effect changes that would have any meaningful impact.

Similar to the smaller company studied there was no general agreement on what things should cost. Considerable disagreement ensued over the cost estimates. And the options of the total estimated costs varied substantially. Often the nucleus of the disagreement concerned the achievement of some technical milestone or breakthrough. Other dominant considerations were capacity level, the timing of the funding, and the validity of the overall requirements. For example, will the company get the follow-on production? When will the drawings be finalized? Can the subs "really make that stuff?" Confidence in the estimate might be represented to the government but in fact no such confidence existed. The principal reason for the uncertainty was the difficulty in meeting the technical requirements. In the time frame permitted apparently all the competitors promised to do something that was technically impossible!

The author was invited to attend a strategy meeting at two A.M. for about sixty employees. The purpose of the meeting was to re-estimate the target cost since the Navy had just indicated that it only had so much money and the previous estimate that the company had made exceeded the dollars available. The program manager said to the group that "they had to go back to the drawing

⁴² Ibid.

board" and think smarter and cheaper. Presumably the pessimistic estimate was used initially but was to be replaced with an optimistic one. There was bitter disagreements over the appropriate costs among the program managers.

In the environment that is described above, the health of an incentive contract is certainly suspect. If a company has to fit the costs to the dollars available, what are the chances for cost reduction? To what extent are overruns built-in? What effect does this have on the goals of negotiation?⁴³ This is addressed again in the section on goals.

Government Environment⁴⁴

Contractor's attitudes toward doing business have several components. Generalizations can be misleading. These seemed to have enough support to be cited. First there was an underlying current of incompetency. "There are some really good people around but the average auditor is a pencil pusher." "The people in key slots and at major commands are on the ball but the skills and motivations of the average employee in Podunk, U.S.A. leaves much to be desired." Generally there was very little sophistication on incentives. This was particularly true as one went into the hinterland and away from the east and west coast. It was observed not only at government installations but also in the companies. And if the parties do not understand the design and management of the incentive, how can they be effective?

Another incident that might have some shreds of truth is the following: Since the government imposes impossible data requirements on a contractor he must keep "another set of books to run the company." This came up often enough to be taken seriously. In one incident a SPO director was coming in and the

⁴³ Ibid.

⁴⁴ See (7), (9), (10), both on (12), (13) and (16).

company was preparing "a dog and pony show" to assure the government team that it was managing the program. The presentation was impressive. The problem was that it had little to do with how the company was really being run. The government team said that it had to have "a full blown CSSR system." The work breakdown structure and related costs and the progress to date were provided in detail. But in fact the reality of the management information system was that it did not accurately relate how the company traditionally got things done. The system, even when installed, did not prevent the normal channels of action and communication from continuing as they had before CSSR. The management confided to me that the information system imposed was of some value but that it was not the system used to manage the company and certainly not worth the cost. It provided a discipline of planning but its implementation in an environment of uncertainty was not practical. How does this impact on the management of the incentive? At best it leaves one with a queasy stomach. Which set of numbers do we use to manage the incentive? Is the incentive ignored similar to the CSSR? How much does the company have to spend to get the system to work? It appears that the government imposes information systems on contractors that are incompatible with their organizational characteristics. This issue came up time and time again. As to its validity, one can only conjecture. But for the cases studied it appeared valid. The management information systems left much to be desired. But then again maybe all of them do.

The major contractors have developed a labyrinth of informal relationships with the government. Most of them have "their retired general" on their staff. There is constant gathering of information. They maintain a Washington office and track and attempt to lobby for their interests.⁴⁵ They routinely visit the

⁴⁵ For a good overview of the industry see Fletcher, Alec, The Defense Industry Complex (43).

Pentagon and the major buying activities to respond to inquiries about their programs and to solicit future business or to resolve current dilemmas. The nature of the relationship and the rules of the game seem to vary with the point on contact and the parties involved. Many of the senior personnel on the industry and government teams have known each other for ten to twenty years or more. Not so at the entry levels. Many of the problems of the contractor's recent college grad and the service's recently commissioned lieutenant are resolved on the golf courses or the restaurants of Washington, Boston or Los Angeles. And so it should be. There is a marked discrepancy between what appears to be going on and what is really happening; there is always a gap between the apparent and the reality. Apparently the individuals involved in the bureaucracies of the government and the large corporations "work the system" to get the job done. There is no inference of unethical practice in this observation. The parties involved, if they benefit, do so indirectly and it is not the motivation for the actions. The intent seems to be "to get on with the work and to get the job done in spite of the cumbersome and sometimes ludicrous regulations." But in the pursuit of getting the job done it "must stand the light of day."

The comments from pilot Case X relating to lower and middle managers throwing their weight around is less appropriate for the large companies. It certainly was a factor but the larger companies apparently have effective channels to the individual's boss so that inappropriate or incoherent behavior does not have to be tolerated. In fact, another interesting behavior occurs. After a government employee works with a particular company for an extended period of time he often takes on the role of an employee of that firm. His interests are often intertwined with those of the company he is auditing or whose contracts he is administering. "Whose team is he on?" is an often heard query.

Is this good or bad? Probably good because it permits the system to get the job done in spite of the bureaucracy. These characteristics highlight the unlikelihood of companies being motivated to underrun incentive contracts.

The Negotiation Process

Major aerospace contractors usually recognize the importance of the negotiation session and place competent capable individuals in these important roles. In the cases studied the senior negotiators had worked with incentives for years and were quite sophisticated. Newer members of the team did not seem to have the expertise required. A company team held preplanning sessions to identify appropriate targets for the various elements of the proposed negotiations.

It is not feasible in this paper to discuss all the parameters of the companies' approach to the negotiation process. But several points are particularly germane. The major concern was protection.⁴⁶ The number one consideration was to avert disaster. Next seemed to be to achieve technical goals. The profit goal was to get as much as possible consistent with protection and technical achievements. The issue of fee came up again and again. Contractors seem to assume that there is a ceiling on profit. Their perception is that the government is only going to allow the contractor a reasonable profit of perhaps six to ten percent. The message comes to them through several channels and the message is clear. What does this imply for strategy? Well, the company establishes a contract where a reasonable profit is secure and then maximizes technical achievement through maximizing dollars . . . not profit. This seemingly resolves a host of apparent inconsistencies in corporate behavior.

⁴⁶ Baron, David, Incentive Contract and Competitive Bidding (136).
Also Hunt, R. et. al. (117).

How does this affect the effectiveness of the incentive? Here is a possible key. The multiple incentive reduces the contractor's risk. It does so in almost all cases. Not all contractors seem to understand this. The average multiple incentive, once the fee pool is allocated to performance and schedule, has a very flat cost share line. When this is combined with high minimums or high ceilings the contractor essentially has a cost contract plus the opportunity to add to the minimum or "fixed fee" through achievements in the schedule and technical dimensions. If the circumstances are right (the government always delays) he can slip schedule, maximize costs, invest in technology and earn a reasonable return. In a sense the multiple helps protect the contractor against the whims of fate in dealing with uncertainty. And in this context the multiple incentive might be serving a vital function. Maybe the multiple incentive is serving a function that is not immediately apparent. This needs further study.

The goals then are to minimize risk (Hunt's risk averters) achieve a reasonable profit, and to invest in the future by allocating as many dollars to technical achievement that is consistent with the above. Organizationally these goals are the purview of different executives. The financial executive utilizes the cost bogeys for control purposes. He incorporates the targets into his budgets. For the cases under study this provided some clues as to the companies inability to minimize costs. What amount was budgeted? Was it the minimum cost, the target, or the costs near the ceiling?⁴⁷ In talking to the controller it was ascertained that the amount was the target costs plus; that is they budget for a point interim between target and the ceiling (cost at minimum fee). The expectation was that this ceiling was probably going to be reached. The controller wanted to protect himself. Internally the

⁴⁷ Ibid.

division managers that were interviewed indicated that there was no incentive to returning money. They spent everything in their budget. There was the usual end of the fiscal year rush to make sure nothing went unspent. If they did not spend all they had asked for they would get less the next year. This is a very common phenomenon that pervades the human community whether in government, industry or universities. Executives were being evaluated on how close they came to hitting their budget estimate. There was no reward for coming in under the budget but there were penalties for exceeding the budget. The principal goal was to maximize cash flow. The executive acted accordingly. To add to the problem of the management of the incentive, it was apparent that the divisional manager had really no appreciation for what an incentive contract was. He certainly understood the concepts in a general sense but felt that significant increases in target profit through large cost reductions simply were not feasible. This was due to the built-in pressures for cost incurrence as established in the budgets developed many months prior to the negotiation of the incentive.

Company Goals and Outcomes⁴⁸

The goals were as stated above: To minimize risk, to earn a reasonable profit and to invest in future business by optimizing cost dollars for technology. The top engineer or program manager used the technical parameters of the incentive as goals for his normally unmanageable engineers and scientists. He badgered them with the specter of an inflamed government. No gold knobs are to be added to the widget. The controller used the goals for divisional targets. The program manager used the cost, schedule, and technical parameters to

⁴⁸See Section VI and VIII. Of note see (56), (58), (59), (70), (76) (82), (113), (114), and (116).

assure timely compliance. So on a macro level the incentive had implications as a base for management. However, on a micro level it appeared to be inoperable. Why?

Part of the problem is because large companies have trouble planning and controlling anything. It simply is not feasible in a multivariate, dynamic non-linear environment dominated by uncertainty. Things get done. But it takes time and dollars. More dollars than one wants to confront initially. The realization of the necessary time and dollars is always more apparent looking back. We seem to have trouble facing their reality when looking forward.

As to outcomes, the contract had implications that neither the contractor nor the government were aware of at the time of the award. Since half the fee pool was allocated to schedule and performance, the net impact on the cost share line was to reduce the alleged 70/30 to a 90/10. For all intents and purposes the contractor had negotiated a CPFF contract. The minimum fee could be increased through the attainment of the schedule and performance goals. This matched neatly with the goals of the company. The contractor maximized cash flow, invested in technology, and made a reasonable, modest return. He slipped cost targets first, the schedule second and his performance goals last. In conclusion, what are the merits of performance incentives in organizations that are strongly professionally motivated to attain technical superiority?

The Contractual Period of Performance

The total performance period was five years; of this, the development portion was twenty months. But as soon as the contract was signed changes were made. There was not a single stable period of the program during the two years of study. The changes, and the frequent redirections of the program such as the cutback in the number of production items destroyed the original intent of the parties. These destroyed the impact of the incentive. But it permitted

the contractor to "get even." Since the pressures of the initial competition no longer applied the proposed pricing of the changes were more realistic. The lesson might be that incentives have to be tied to time periods that are consistent with the awards. Complex incentives stretched over long periods of time are meaningless as motivators.

The Government's Contract Administration Process⁴⁹

The conclusions on Pilot X are applicable to Pilot Y. Not only is there a seemingly endless array of visitors to check what is going on but there is also a resident government team looking over the company's shoulder to see if all is going according to regulations. The companies are subject to preaward surveys, surveys during the contract and post-contractual surveys. The time consumed is very costly and in many instances this cost has to outweigh the benefits.

On one of the large programs studied, the Air Force SPO Director was involved in even the most minute details. He constantly monitored all the facets of the program. He requested and received regular briefings. He requested and received detailed reports concerning all aspects. The SPO and the contractor lived together. They were in constant touch. The organization of the SPO mirrored that of the contractor (or is it the other way around). In this context the progress of the incentive was managed by both parties. The government team forced the contractor to provide data on progress. The government asked questions on targets. The contractor responded. And yet this very contractor had no ongoing organization to implement internally the incentives provided within the contract. Much of the effort of the SPO was directed toward the schedule and performance goals and to avoiding overruns. Both parties seemed

⁴⁹ See (106), bottom of (108), and bottom of (110).

to work to the same covert targets. Significant underruns are not easy for the government to explain. When they occur the implication is that the government buyer did a poor job in pricing and that the contractor sold him a high estimate for the target. Apparently neither party to the contract really wants the publicity of a major underrun and the innuendos associated with it. The successful programs probably have had a team approach where both team members cooperated to beat or at least work the system.⁵⁰

Another characteristic of the larger corporation is that it has some corporate memory. This permits judgments as to what can be done and what cannot be done; what is a reasonable expectation and what is not. Within this milieu the contractors can often be heard to say, "Here we go again."

Organizational Problems that Affected the Incentive

The large aerospace firms reflect the state of the art in the organizational skills of planning, organizing and controlling the operations of the company. Yet there are some unique problems. These include a single customer, the nature of doing business with the government, the nature of the product and the nature of the market environment. For example, the organizational structures are different than those in the nongovernment market. Marketing in a sense is a dirty word. The contracting function is very important. Much of the business comes in through the bidding process. Negotiation plays a key role in success.

What are some of the common organizational problems and how do they impact on the incentive?⁵¹ They seem to be as follows:

⁵⁰ The services (i.e., Army, Navy, Air Force) appear to have different philosophies on this point.

⁵¹ See Hunt's work such as 117 and 119.

1. The instability of sales due to the government's market demands patterns.
2. The risk associated with the large capital requirements of major programs.
3. The inability to fund from earnings the research and development required to remain a viable competitor in the market place.
4. The attitude toward profit. It is wrong or sinful to make a larger profit than the normal market profit.
5. The arbitrary and unilateral nature of the customer-buyer relationship.
6. The inability to define the product and the inability to maintain a technological approach due to the high rate of technological obsolescence.
7. The basic noneconomic character of the process. Much of Department of Defense aerospace weapons business is concerned ultimately with the defense of the nation. In times of crisis this is the paramount consideration.
8. Much of the research for commercial ventures is funded through DOD business.

Can an incentive based on profit maximization function effectively in the above environment? It is not that companies are not motivated; it is a question of the appropriate motivational elements for a given environment. Apparently short-run profit does not work.

General Conclusions

Competitive Environment⁵²

1. There exists strong competitive pressures to buy-in. The term buy-in refers to a situation where the contractor is willing to produce a product or provide a service for less than its normal price. The nature of the buying process, the best-and-finals, and the limited number of programs available all contribute to this behavior.
2. Corporations that have CPIF contracts often subcontract out a large portion of their cost of goods sold on a fixed price basis. If this

⁵²See (41), the bottom of (43) and (87).

is combined with a high fixed asset base in an environment of capital intensity the wisdom of the use of cost incentive becomes dubious.⁵³

3. Minority and small business manufacturers often used a disproportionate amount of time for the management of their contracts.

Company Organization

1. There was no formal organizational unit to track and manage the incentive.⁵⁴
2. The financial manager often used the ceilings for budget purposes.
3. The "technical side of the house" used the performance incentive parameters for goals. The engineers were not aware of the profits associated with the achievement of the particular goals.
4. There was no general emphasis on cost reduction. But rather the emphasis was on technical achievement. Engineers historically have not been cost conscious. If given the opportunity an extra dollar was spent to assure that the item worked, or to extend the frontiers of knowledge.
5. The organizational structure was typically a combination of the matrix and functional forms. There was a great deal of duplication. Particular responsibility for the incentive was difficult to pinpoint.
6. The contracts group knew more about the incentive than anyone else in the organization and were for the most part the only group that placed much emphasis on its importance.
7. Once the contract was negotiated and in-house it was business as usual.⁵⁵

⁵³Redden, Edward G. (52) and Jones, Troy (70) have interesting discussions of these points. See also Hunt et al. (117).

⁵⁴Several in-depth studies addressed this. See Hunt et al. (117), LMI (74).

⁵⁵NASA, summary of Booz-Allen Study (56), Fisher (58).

The incentive contract did not receive any different administrative treatment than the other types of contracts. This was particularly true when there was a large number of contracts and when the incentive represented a relatively small proportion of the total contract dollars.

The Accounting and Financial Systems

1. Computerized sophisticated information systems did not provide the ability to track and manage the incentive contract.
2. Data for short-run decisions was not available.
3. The company's budgets are often geared to the target cost or higher. It is therefore not feasible to expect less than the budgeted costs. This could explain why many of the contracts seemingly end up near target.
4. It is not possible to estimate within reasonable limits the costs of programs to which a very high uncertainty is attached.⁵⁶
5. Often the goal for management was cash flow. High cost incurrence often generates high cash flow through progress payments.
6. In an environment where a company has to fit the costs to the dollars available, where best-and-finals and similar competitive pressures dominate behavior, where uncertainty is a fabric that weaves its way through all elements of the business, the potential of an incentive contract is certainly suspect.

The Government Environment

1. There is an overriding attitude that government middle management personnel are "eight to fivers" and generally, if not incompetent, uncaring. On the government's side the attitude too often expressed is that the contractor is at best an opportunist, on the average unethical, and at the worst a crook.

⁵⁶ See Section IX.

2. Both industry and government personnel reflected a lack of sophistication in the fundamentals of incentive contracts.⁵⁷
3. The government imposes management information systems that either cannot be used by the contractor or were not in the cases studied.
4. The government imposed management information systems that were inconsistent with the way the companies functioned. This therefore required the company to "keep two sets of books."
5. The contractors studied had developed a myriad of informal working relationships with the government structure. This varied by level in the organization. In successful programs individuals teamed together to get the job done "in spite of the dumb regulations."
6. There appears less likelihood that a government CS9 could throw his weight around in a large company. But the risk is still present. A "new kid on the block" with a new warrant or shiny new lieutenant bars could still wreak havoc.

The Negotiation Process . . . Goals and Outcomes

1. For the most part, major aerospace firms recognize the importance of the negotiation process and place competent individuals in those jobs.
2. The major concern, and therefore the major goal of negotiation was protection. This was achieved through contracts that minimized risk.⁵⁸
3. The chief negotiators placed little credence in their own people to estimate the costs accurately. They therefore put in a safety margin if possible.

⁵⁷ See (56), (61) and particularly (78).

⁵⁸ See Baron, D., Incentive Contract and Competitive Bidding (136). Also Moore and Cozzolino, J. (139).

4. After protection, the companies wanted technical achievement. Technical achievement was important since it reflected on reputation, it improved competitive position, and it provided for possible commercial fallout.⁵⁹
5. The firms maximized dollars not profits. The government both by its attitude toward high profits and its regulatory constraints limited the amount that the firms could reasonably be expected to earn.⁶⁰
6. The multiple incentive reduced the contractor's risk particularly if appropriately structured.⁶¹
7. As to priorities on multiple parameters, first technical, then schedule and lastly cost. Therefore cost was slipped first, then schedule and finally performance.
8. Companies budgeted for targets plus, and not the minimum.
9. On the macro level incentives were rarely used as a tool for the management of the contract.
10. The contract by its very nature had built in implications that neither the contractor or the government recognized at the time of negotiation.
11. Companies had trouble planning and managing their programs: this was due to the multivariate, dynamic, non-linear environment and state of the art products. Uncertainty was the villain.
12. There was not a single stable period during the time that these contracts were studied. Changes were constant.
13. Incentives have to be tied to the time periods that are consistent with the achievable goals and for which the rewards or penalties are applicable.

⁵⁹ Ibid.

⁶⁰ NASA, Defense Industry Profit Review: Volume I (67).

⁶¹ See Jones, Troy (70) and LMI (74).

14. Performance periods have to be relatively short. Otherwise incentives lose their effectiveness.

The Government's Contract Administration Process⁶²

1. The administrative process seriously impedes the effectiveness of the incentive. This is not to infer that administration by the government is unnecessary. It means simply that in an environment of constant second guessing, interference, and unpredictable audits that relatively small profit increases lose their significance.
2. There is much to support the idea of a team working together under a rather flexible contractual umbrella to get the job done.
3. Much of the efforts of the government drives the contractor to using all the dollars that he had available under the contract. There is always something else that it would be nice to have! And by all means let's not give any money back. SPO directors want first and foremost to have an effective weapon system at the budgeted cost. He is more likely to assure that end by spending the dollars that are available.

Organizational Problems that Affect the Incentive

1. There is no evidence that corporations manage incentives to optimize short run profit. This varies somewhat with the relative importance of the program.⁶³
2. There are some unique problems of doing business with the Department of Defense. These include the nature of the marketplace (both the demand and supply functions), the administrative regulatory framework, and the nature of the products.

⁶²See (106), (108) and (117). Generally much of Section VI is applicable.

⁶³Almost all studies to date support this observation. See Section VI.

3. Much of the business comes into the corporation through the bidding process.
4. There is instability in market demand functions.
5. There is a very large risk associated with many proposals efforts. Costs for even a modest effort often exceed fifty thousand dollars. Often the price is millions.
6. Companies cannot afford to fund adequately research and development through earnings.
7. There is a basic non-economic character in the weapons business.
8. Much of the research for commercial ventures is a derivative of government research and development expenditures.⁶⁴
9. There is a constantly changing technological base. Product life cycles are very short.
10. The attitude toward the constraint on profits force a shift away from the traditional notions. To understand a DOD contractor one must first comprehend the impact of an artificially determined profit ceiling.

Insights on the Hypotheses

1. The Type of Contract is not the Determining Variable in Contractor Behavior.⁶⁵
 As with the small companies, but probably even more strongly this hypothesis appears valid. The contract type established the upper levels of expenditures and defined the goals through the specifications, program requirements and schedules. But these are or can be the same regardless of a defined incentive. The fixed price has the most. It depends on the contractor's goals. To the extent that contractors are risk averters the incentive contract is more desirable than a fixed price but less than a CPFF. Multiple

⁶⁴See 34, 39 and bottom of 43. See also Hunt 117.

⁶⁵See 34, 56, 58, 59, 61, 70, 74 and 79.

contracts are often more desirable than straight cost.

2. Most Incentive Contracts End up Near Target

A more appropriate statement might be that contractors and SPO directors spend all the dollars that they can obtain. The process of internal budgeting to target plus, and the timing implications drive the costs to at least target. Other factors include the priority for technical achievement which at least means spending what is in the budget. Sometimes it means optimizing dollars under the incentive up to the ceiling to invest in the next procurement or to develop technology for commercial ventures. Much exists in the research literature that statistically establishes that contracts since the advent of incentives have clustered around the target costs.⁶⁶

3. The Target Cost of Incentives is Higher than Targets of Alternative Contracts.⁶⁷

There was no basis for studying this question. See comments on small company pilot study.

4. The Most Significant Factor in Determining the Target Cost is Where you Expect to End Up.⁶⁸

This has to be modified. Competitive pressures, the anticipation of changes, follow-on business and related factors determine bidding targets. In the negotiation sessions the driver is risk reduction or aversion, profit satisfaction (whatever the situation defines as reasonable) and technological maximization. In this context the target is negotiated at a level where these goals can be achieved.

⁶⁶ See 52, 59, 61, 70, 79, 80, 82 and 89.

⁶⁷ See 70, 74.

⁶⁸ See 52, 56, top of 58, 65, 74 and 81.

5. In Many Instances the Government Administration of the Incentive Destroys any Opportunity for the Incentive Work.⁶⁹

It might not be the administration of the contract as much as the nature of the process itself. High profits are taboo. Also costs are driven toward target or near it. And there is the specter of disallowances. But the administrative process is not without sin. The inability of the government bureaucracy to respond in a timely fashion is a major factor. The constant reassessments and second guessing is a second problem area. And the constant shuffling of personnel is a third. Rewards to be motivators have to be understood, attainable and promptly provided. The administrative process to the extent that it impedes that process renders the incentive mute and impotent.

6. The Cost of Administering the Incentive Might Offset any Savings that Might be Achieved Through the Contract Arrangement.⁷⁰

It appears to be more than the administration of the contract that drives the costs to target or above. However, there is little doubt that the cost of the administration of the incentive is excessive. One must look seriously at the nature of the administration of incentives. This area needs careful evaluation. What does an incentive contract require over and above a CPFF or a fixed price? How does it compare to the cost of an award fee? Are the administrative burdens excessive? The Navy appears to have a different philosophy of administration than the Air Force. The Navy does less checking and hand-holding than the Air Force. Why? Are there valid reasons for the different approaches? This should be explored. It is hoped that a

⁶⁹ See 61, 70 and 117.

⁷⁰ Ibid.

joint meeting among the services to explore such inquiries can be undertaken in Phase III of this study.

7. Many of the Contractual Arrangements are Intended for Intentional Overrun.

Technically anything within the price ceiling of the FPI or the minimum of the CPIF have different probabilities of occurring. Contracts as noted are often negotiated by aerospace companies to reduce or minimize risk. The downside risk is cushioned. In the contracts studied both the SPO and the contractor wanted to spend the money available to assure technical achievement and to do a variety of things not originally contemplated. Flexibility was built into the contract. Massive overruns or those outside the cost swing implied in the contract were not intended.

8. Many Incentives are Inappropriately Structured. What Started out as Rules of Thumb have Become Biblical.⁷¹

In all the contracts studied there was evidence of an inappropriate use of incentive rules of thumb. The contracts were applied without adequate attention to the particular situation. There was not sufficient tailoring to the probable motivational drives of the contractor and the realities of the procurement. The patterns did not reflect the very high probability of overrun and the almost nonexistent probability of an underrun. Traditionally target profits were arbitrarily applied. Fee pools were too limited to offset the advantages of incurring costs to contribute to overhead. In many instances it made a lot more economic sense to overrun than to underrun because of the capacity considerations of the company.

A probable cause for the lack of sophistication was the unavailability in recent years of training. Apparently nobody thinks it's necessary

⁷¹ See (74) and bottom of (76).

to provide training or to send employees for training. This is an area that needs immediate attention.

9. Penalties are Better Motivators than Rewards.⁷²

Much of the traditional literature in psychology suggests that positive rewards are more influential in obtaining desired behavior than penalties. Penalties even run the risk of encouraging the very behavior that one is striving to eliminate. In spite of the common wisdom, it might make a lot of sense under the competitive pressures of typical weapons procurements to use penalties to prevent undesirable behavior. The rewards available through incentives seem to be inadequate given the nature and level of profits acceptable to the Congress for government contracts to actually motivate contractors to substantially underrun costs.

The penalties could take the form of ceilings. They should be more like constraints than penalties. Penalties would apply after the ceilings were penetrated. It is not suggested that positive rewards be dropped. However, when the extracontractual factors suggest that the fee pool is inadequate as a motivator then constraints and penalties provide a basis to motivate the contractor to meet contractual targets. Certainly for the contracts studied the likelihood of the traditional incentive to work was nil. A few more points of profit was far outweighed by the economic sense of maximizing dollars.

10. The More Complicated the Incentive Arrangement the More Likely it will be Ignored.⁷³

Even the simple incentives are often ignored due to economic disincentives

⁷² See (21) and (56).

⁷³ Ibid.

hidden in the contractual situation. The complex incentives are almost impossible to administer and implement. That might not even be the intent of the contractor. In one of the contracts reviewed the multiple contract provided flexibility to the contractor. It permitted him to "blow smoke" so that the government did not have as much visibility into the costs of the contract. Its intent was to maximize confusion with the resultant minimization of risk. This is certainly not a desirable behavior for a contractor. Yet it is not uncommon.

Another aspect of the complex multiple incentives that is often overlooked is the impact that it has on the fee pool for the cost segment of the contract. By the time the fee pool is diluted through the allocations to schedule and performance the cost share ratio is usually down to about five percent! Too often the contracting parties are not aware of the impact on cost. If the government is not aware, and the contractor is aware, the situation is even worse.

11. The Most Important Element in the Incentive is the Performance Element.

Contractors Readily Slip Schedule and Cost to Achieve Performance Goals.⁷⁴

This hypothesis was supported. Researchers into the nature of incentives have questioned the necessity of performance incentives. Are not the contractors professionally motivated to achieve the performance goals? Do not the specifications define the required standards for performance? Why do we need to further incentivize performance? It is a good question. The contractors studied were motivated on their own to produce a superior technical product. The basis for future business is often technical competency and reputation. Even at the penalty of lost fee, performance goals are

⁷⁴See Section VI. The Booz-Allen study for NASA (56) and the study of Colonel Troy Jones (70) are two of many that analyze this issue.

pursued. The appropriateness of performance incentives needs to be reconsidered.

12. Incentives Have to Have Organizational Visibility to Work.⁷⁵

This addresses the query raised eloquently by Hunt in his provocative and well researched papers. This pilot study does not answer that question directly. What was apparent and germane to the issue was the absence of implementation within the organization. To the extent that there is no organizational liability to not making the contract work, little heed is paid to it. Individual responsibility, one would hazard a guess, could achieve that end.

13. CPIF Contracts are Fundamentally the Same as CPFF Contracts.

There was not an opportunity to study this point. But many of the CPIF contracts were essentially CPFF. For example some contracts when carefully analyzed turn out to have flat share lines. The multiple incentive that apparently had a 70/30 share on cost really had a 95/5. It is not difficult to design a multiple incentive that is close to a CPFF in terms of cost share. In addition it has the potential for higher fees through performance and schedule bonuses. In some ways multiple incentives can provide for almost as much protection as a CPFF and they can have the additional advantage to the contractor of hopefully confusing the government so that they can achieve greater management flexibility.

14. Cost Type Contracts Result in Inefficient High Cost Producers.

This question was not addressed in the pilot studies.

⁷⁵See Hunt's work such as 117.

CONCLUDING REMARKS

This part of the study clearly suggests the need to revise current incentive procurement methods. Tentative ideas at this point include the need to:

1. rethink the specific goals of the incentive.
2. more accurately assess and reflect contractor motivations.
3. develop new incentive structures that match contractor motivations.
4. find out why industry does not implement incentives.
5. reassess the use of performance and schedule incentives as to form and application.
6. carefully assess profit levels -- fee pools as they exist are inadequate motivators.
7. streamline the administrative process to permit the incentive to function.
8. rebuild a viable, constructive, cooperative team atmosphere between the government and industry, and
9. implement a broad training program to provide responsible individuals with the necessary background to perform their jobs.

Since the sample is relatively small the results must be viewed with prudence. The results of the questionnaires, the interviews, the workshop, and the literature base are combined, analyzed and synthesized into final conclusions and recommendations in Volume One.

As a final note, this Volume II can be best comprehended after studying Volume Three. To fully appreciate the implications cited one needs to be familiar with the research base. Ample cross-reference has been provided. Each major section of this paper is supported by the related Volume I literature base.

III

VOLUME III

**SYNOPSIS OF INCENTIVE RELATED ARTICLES,
MANUALS, PAPERS AND STUDIES**

I. Introduction

In a scathing indictment of incentive contracting in a 1960 report in support of the Renegotiation Act, the Honorable Carl Vinson, then Chairman of the Armed Forces Senate Appropriations Committee, sounded the distinction between extra profits resulting from inflated estimates of initial costs and those associated with improved performance. Carl Vinson's conviction of the innate evil of the incentive type contract fueled his determination to see the Truth in Negotiation legislation become law.¹ In a 1943 article by Glenn Loyd,² the incentive type contracts are criticized as having targets that are too high. In his article he also refers to similar experiences from World War I. And in a 1923 contract court case of J. J. Preiss and Co. v United States, the Court of Claims reviewed the bonus provisions (80-20) and concluded that "contracts of this character will not be looked upon with favor by this court."³ Yet in 1963 Secretary McNamara's first Armed Services Progress Report to President Kennedy we find: "Our best estimate is that for every dollar shifted to firm fixed price and incentive contracts, we should be able to reduce final costs by at least 10%. . . ."⁴

¹See: "Truth in Negotiation: The Legislative Background," Herbert Roback, a paper presented to the American Bar Association, Honolulu, August 8, 1967.

²Glenn A. Loyd, "Pricing in War Contract," in Law and Contemporary Problems 235 (1943).

³J. J. Preiss & Co. v U.S., 58 Ct. of Claims 81.

⁴Secretary McNamara's report to the President: First Armed Services Progress Report, July 8th, 1963, pp. 8 and 9.

These past two and one-half years (2 years with support) have been spent trying to unravel the dichotomy of opinion suggested by the events recorded above. The drudgery of tedious research of sifting through the microfiche and old musky files was mollified by the knowledge that I had played a part on that stage in the late fifties and early sixties in the development and implementation of the incentive contract philosophy. It is time to look back and see if in fact a monster had been created. It is hoped that this bibliography will provide a rich source of information for future practitioners, legislators and scholars. The materials are organized to allow a convenient access to research on the relevant issues. This is the only document available that summarizes and organizes the existing literature.

Organization

The important papers, books and studies are synopsized and organized into relevant categories. The particular items were selected to provide a balanced and representative review of the literature available. Eleven sections are included: they range from the early history to recent application. Alas, it must also be recognized that the representation was constrained by the element of time and space. As noted earlier this literature summary was the first phase of this study.

History of Incentives

The literature clearly reveals that incentives in contracts are not new. Incentive type contracts were used during World War I (bonus-for-savings) and World War II (target price contracts).⁵ As revealed in the congressional

⁵ History of Incentive Contracts. Chapter One of Incentive Contracting, Contract Management Institute, 1966 by Bass, Nolan, and Kennedy, pp. 2, 3, 4.

hearings of the late fifties, incentive contracts were widely employed in the fifties and received avid reviews by the Armed Services Appropriation Hearings in those years. The principle contract type used was the FPI. During the fifties its use varied from a high in 1954 of 25% to a low of 9% in 1951. CPIF contracts averaged about two or three percent starting in 1953. But the real headliner of the fifties was the CPFF which went steadily from 8.6% in 1951 to 36% in 1960. Several events appear to have influenced the McNamara thrust to reducing CPFF. These included (1) the increasing amount of money required to develop weapon systems and the ensuing shift in the purchase of research and development from an overhead item in the purchase of the end item to a line item or a separate contract. (2) the massive overruns of the fifties as revealed through congressional and GAO studies, (3) the criticism of cost type contracts voiced in scholarly academic studies such as The Weapon Acquisition Process by Scherer and Peck which highlighted overruns on 12 systems averaging 320% and ranging from 17 to 700%, . . . and (4) the impact of the Monterey, California Conference of 1963 at which convened the captains of industry and the generals and admirals of the services to study acquisition policies and make the necessary changes to the current policies to implement the recommendations. As a result of the above, goals were set by McNamara for the reduction of the CPFF contracts and the implementation of incentives. In fact the percentage of CPFF contracts were reduced from a high in 1962 of 38% to 12.3% in 1963. The Department of Defense in 1962 moved rapidly to implement incentives. It:

- A. Revised ASPR Section III, Part 4 to emphasize and explain the incentive approach, March 8, 1962.
- B. Published first incentive contracting guide October, 1962.
- C. Published a revised Air Force Guide to pricing 70-I-3.

- D. Prepared and distributed two informal training guides on incentives and value engineering. July 2, and August 1, 1962.
- E. Trained 1800 Air Force personnel in one day incentive contract sessions between 14 September and 25 October 1962.

Part of that session stated that "The name of the game is incentives, the CPFF contract is dead."⁶

Thus was born the modern era of incentive contracts. These contracts with increasing complexities and sophistication were used throughout the '60's and '70's. And with varying degrees of success. As the literature demonstrates the critics continue to chew at the heels of the stallion. Numerous studies were undertaken to prove or disprove the validity of the incentive contract concept. The studies particularly thrived in the late 60's and early 70's. These were conducted, for example, by the government oriented think tanks (Rand, LMI, IDA) and at DOD oriented graduate programs such as MIT, Berkeley, Stanford and Ohio State Universities. The students were usually but not exclusively military officers or government employees. In addition the subject began to attract a small cadre of academicians . . . particularly economists attracted by the work of Scherer and Peck and operations research faculty attempting to model the incentive process or to tackle the problems of decision making under various levels of uncertainty. Over this same time span the fundamental philosophy of weapon acquisition has varied. Program definition, Fly Before you Buy, Life Cycle Costing, Multi-year Buys, Weighted Guidelines, Award Fee contracts, CSTS's and related concepts have in a dynamic sense formed the milieu within which the contract was operable.

⁶USAF AFSC Management Conference Newsletter 9, page 39, 18 February '63. One of the Periodic newsletters on follow-up on Monterey Conference.

Taxonomy

Several organizational formats were suggested. The decision process could have been a sound basis of departure. Similarly a schematic of the inputs and outputs of contracting for weapons systems would have been feasible. Perhaps the use to which the data would be put would also have been helpful. After working with these and several others, it was decided to use the format that would best assist the completion of stages II and III of this project. Therefore, the papers were organized primarily to provide for the easy and convenient access to evaluate the project's hypotheses.

Methodology

Each of the tapes synopsized was personally read in its entirety. The impressions were taped and the tapes typed. The master bibliography was compiled initially from the bibliographies from the papers reviewed. The initial list was compiled from sources at the major DOD procurement schools, educational centers and the review of the traditional trade and academic journals. In addition, the materials from the author's private collection was taped and reviewed. In some instances the author's copies of materials from the 50's and the early and middle 60's appear to be the only copies left in print.

Materials and suggestions for materials were received from across the country after the NCMA Newsletter article on this research project. These were included as appropriate.

II. History of Incentive Contracts

The review of the literature clearly documents that the incentive contract is not a new idea in the annals of the procurement world. Incentives were used during World War I and World War II; the type and kind varied but the concept and assumptions seemed to be the same. Rapid growth occurred in the fifties. Witness Karl Vinson's fight as noted in the synopsis paper on page 13 in this section. But McNamara gave them his support and the Monterey Conference placed them as high priorities and implemented the necessary legal approvals to launch them in their dominant use in the sixties. The following papers and articles in this section partially trace this development. See also the history of incentives in the Kennedy, Nolan, Bass Manual on incentive contracting under the section in Incentive Contracting Manuals.

1. First Aircraft For U.S. Army: Advertisement and Specification for a Heavier Than Air Flying Machine, Allen, James. Brigadier General, Army Archives, Dec. 23, 1907, 3 pages.

This contract is often quoted as a first example of the use of an incentive; but it is not the first. See page 19 for earlier usage. The document outlines the conditions of product acceptance under a general heading of General Requirements. There are 14 listed requirements for the bidders. The aircraft is to fly at least 36 MPH: forty miles an hour is set as the target and deviations from target are associated with different costs to the government. The bidders had to submit costs associated with speeds ranging from 36 to 40 MPH. Paragraphs 5, 6 and 7 spell out the terms of acceptance. There were six days allowed for response.

2. Negotiation Handbook, #ORDM 42, Gruver, E., Office of the Chief of Ordinance, U.S. Army, June 1, 1951, 69 pages.

This manual is an excellent source for the policies and procedures of the Army ordinance in 1951. Of particular interest is the negotiations checklist in Appendix 1. Also of interest to the student or practitioner of incentive contracts is the philosophy associated with competition, pricing, facilities, and type of contracts. On page 12 it reviews the type of contracts used by the Army and their appropriate application. There is absolutely no mention of the incentive contract in this section or for that matter anywhere in the manual. The only item that even approaches the concept of the incentive is the form five of the fixed price redeterminable type contract. Incentives were to be allowed only where the contractors' performance had been outstanding. The document includes a selection of the factors that are normally considered in the determination of contract type. Included are the firmness of the requirement, the need for flexibility, and the nature and extent of government furnished property. The statutory limitations on profit by contract type were discussed: for cost type contracts the fee limits were 10 percent generally. The exceptions were 15 percent for R&D and 6 percent for architectural contracts.

3. An Analysis of the Management System for the Development and Support of Propulsion Engines, Kennedy, John J., Ohio State University, 1959, 37 pages.

This masters thesis describes an innovative approach to the development and support of propulsion systems. Initiated in about 1956 this system provided for a comprehensive management system for the Army, Navy, and Air Force's development of weapon systems propulsion engines. The focus was the aircraft and missiles engine advisory groups (key generals and admirals) that

met at regularly scheduled meetings to review and approve the entire spectrum of development of engine systems including rockets, nuclear, jet, and air breath systems.

The system is of particular interest because of its flexibility and its freedom from cumbersome regulatory constraints. The paper is in several parts:

- A. Introduction . . . Importance, limitations, organization;
- B. The product improvement system . . . Policies, procedures et al;
- C. Evaluation of product improvement system, and
- D. Recommendations and conclusions.

The system came into being when development costs were pulled out of the final price of the end item. This combined with the sharply increasing expenditures for R&D led to the development of an informal system for the review of R&D for all Services by the Aircraft Missiles Engine Advisory Group. This paper describes the development of that system and its strengths and weaknesses.

4. Air Force Systems Command Manual--Procurement Contract Management Manual, Headquarters, AFSC, July 14, 1961, 101 pages.

The nature of contract management and its constituent parts are the subjects of this document. It has three chapters: contract management teams, guidelines for critical areas of contract management, and special areas of consideration.

As of '61 the ASPR identified the following contract types: fixed price, fixed price with escalation, six types of fixed price with price redetermination, two types of fixed price with incentive formula cost plus incentive fee,

cost plus a fixed fee, cost, cost sharing, time and material, labor hour, performance incentive, and value engineering incentive.

The appropriate contract type is ascribed based on the stage of the procurement. Eleven stages are presented: these included the basic exploratory research, the feasibility study, the design study, the blueprint and breadboard mock-up (CPFF), the prototype, the test program, production engineering (CPIF), the first production (FPI) and finally subsequent production (FP). This document gives a valuable insight into the then proposed policies on contract usage.

5. Management Procedures at Electronic Systems Division Briefing to the Commander AFSC, ESD, USAF, April 27, 1962, 12 pages.

The document summarizes the briefing by Colonel Scurlock; it has five sections: 1. Systems Management, 2. Configuration Management, 3. Consolidated Program Management, 4. Financial Management, and 5. Procurement. The latter section on procurement has a description of the electronic systems division's approach to contracts.

The purpose of the briefing was to explain the cost overruns. These were: 1. Contractor Buy-ins, 2. Inadequate specifications, 3. Unforeseen engineering problems, 4. Revisions and refinements of needs, and 5. Overhead adjustments. Of these, the largest number of overruns were caused by upward overhead adjustments. However, the greatest dollar overruns were caused by one or a combination of the others. The remedies offered include one on the use of incentives. The provisions for cost control were: 1. Complete specifications, 2. Detailed cost estimates, 3. The use of incentive-penalty provisions, and 4. Expenditure management reviews and controls.

On incentives . . . "to us, the standard ASPR cost incentive provision is slanted too much toward increasing the fee for cost reduction and not enough toward penalizing the contractor for incurring an overrun in costs." Toward that end, the SPO's were directed to apply penalties to the existing incentive contracts. It was recognized that each contract had to stand on its own. In the concluding section the problem of the letter contract is discussed and its impact on overruns recognized.

This is a provocative document. It cited the major causes as perceived by ESD for overruns. Could incentives solve these problems?

6. The Department of Defense as a Buyer, Kennedy, Dr. John J., School of Systems and Logistics, Ohio State University, October, 1962, 22 pages.

The paper covers six areas: 1. The development of procurement law, 2. The organization for procurement in the Department of Defense, 3. The basic functions of procurement law, 4. The methods of procurement, 5. The types of contracts, and 6. The contract clauses. Of particular interest for the incentive contract and the development of contract law, some statistics on method of procurement and the use of contracts.

The applicable statute was the 3710 statute of March 2, 1861. These were revised in 1869. These provisions made competitive advertising mandatory except in emergencies. In 1916 in anticipation of war the National Defense Council chaired by Bernard Baruch was created, and the 1858 statute was revised to permit negotiation. Between the first and second world wars the policy reverted back to the 1861 statutory requirements for formally advertised bids. During World War II negotiation again became necessary. In 1947 Congress passed the Procurement Act which provided the services with greater flexibility and permitted negotiation under seventeen stipulated

circumstances. From 1951 through 1959 negotiated procurements averaged more than 82% of OOD dollars. In that same time period cost type contracts increased from 12.7 percent to 45 percent. Fixed price types declined proportionately. In 1959, 3.2 percent of all contract dollars were on CPIF contracts and 15.3 percent on CFI. At that time incentive contracts could only be utilized after it was formally determined by the contracting authority that (1) this method is likely to result in a lower price than optimal means, and (2) it is impractical to acquire the desired item without the use of such a contract.

7. Copy of letter sent to the Industry Associations by the Office of the Assistant Secretary of Defense, Weighted Guidelines, Washington, D.C., August 8, 1963, 2 pages.

This letter accompanied the proposed change in ASPR 3-808 that had been revised to provide a new defense profit policy to use the profit motive as a stimulus for effective and economical contract performance. The paper attached outlined the weighted guidelines technique to be used in the determination of the target fee for the negotiation session. The letter notes that the ASPR had been revised to eliminate the administrative fee limitations for cost type contracts. This opened the way for the use of the higher fees associated with incentive type contracts. The letter was signed by the then chairman of the ASRP committee, Colonel William W. Thybony.

The attached draft of the weighted guidelines ASPR provisions included a range of fees associated with the different type contracts:

Cost plus a fixed fee	0 - 1%
CPIF--cost only	1 - 2%
CPIF--multiple	1 - 3%
FPI--cost only	2 - 4%
FPI--multiple	3 - 5%

FPI--prospective
PRP

4 - 50
5 - 70

8. 175 Series Manual Weapons Acquisition, USAF, AFSC Systems Program
Management Manual, March 16, 1964, 31 pages.

This manual has an excellent chart outlining the acquisition process. And it is interesting as an historical document on the policies and procedures as they existed at that time. It has four parts: (1) Conceptual phase definitions, (2) Definition phase, (3) Acquisition phase, and (4) Operational phase. Of particular interest to the incentive study is paragraph 2-45 wherein the contractor must initially provide an incentive arrangement specifying a value statement for the multiple incentives and the proposed use of the incentives to assure the attainment of the contract objectives.

9. Monthly Summary Report, NASA Incentive Contracts, Christenat, H. B.,
Director Incentives and Pricing Division, Office of Procurement, NASA
Headquarters, June 15, 1965, 84 pages.

This summary report is an example of the in-house data that the services maintained for their own use. In fact the document is not for public dissemination and is marked as such. This is one of the monthly summaries of all the NASA incentive contracts that were in being at that time. It contains four parts: 1. Contracts awarded, 2. Contracts in negotiation, 3. Evaluation of incentive effectiveness, and 4. Incentive contracts currently under administration. Of the 112 contracts, 57 were CPIF, 7 were CPIF/CPAF, 23 were CPAF, 22 were FPI, 1 was an FPI/CPAF, and 2 were.

A summary statement is provided on each contract. These documents would provide an interesting source for the analysis of incentives.

10. Truth in Negotiation: The Legislative Background, Roback, Herbert, Military Operations Subcommittee, Committee on Government Operations, U.S. House of Congress, August 8, 1967, 36 pages.

The truth in negotiation legislation was hotly debated. This summary paper on its emergence is divided into the following parts: (1) GAO interest in contract audit, (2) Government response to defective pricing, (3) Mr. Vinson's fight against incentive contracts, (4) House action and Senate deferral, (5) Interim reconsideration, (6) Issues on the Senate side, (7) The industry view, (8) Drafting a bill with exemptions, (9) Proposal to amend, (10) The 100,000 dollar floor, (11) Offsets of faulty FAA data, (12) Knowledge of faulty submission, (13) Mandatory exemptions, and (14) Making it work. There are 113 footnotes.

Mr. Karl Vinson, a pioneer of profit control legislation in the 30's, and at the time chairman of the Armed Services Committee was adamantly opposed to incentive contracts. He thought of them as profits on profits and alleged that contractors made profits through merely increasing targets rather than improving performance. Mr. Vinson had sponsored the Vinson-Trammel Act, the Smith-Vinson Bill on the eve of World War II, and led the fight for the Renegotiation Act of '51. He then went after incentives which he saw as a pernicious device. The paper notes that the incentive method reached the zenith of its trial period in the late 50's. The giant space companies, led by Boeing, contested the Renegotiation Act in the tax courts. They wanted assurance that the incentive profits once earned would not be drained off through renegotiation. After an extension of the bill successfully passed the congress, Mr. Vinson in an effort to stem the tide of incentives led the fight for cost certification and truth in negotiations. Along the way he introduced numerous studies that had been conducted by the GOA alledying abuse by the incentive

contract. The conditions for adequate procurement were defined by Comptroller General Joseph Campbell to be: (1) maximum competition, (2) complete and accurate cost information, and (3) selection of the proper contract type.

Mr. Vinson was convinced that the proper type was not the incentive. Between '57 and '63 the Comptroller General made 82 published reports to the congress on over-pricing under contracts negotiated by the three military services.

Prior to '57 there were no audits on fixed priced contracts.

The notes provide a rich source on the history of incentives. For example the study by the Comptroller General in 1959 of twenty-five large aerospace firms making the largest repayments for excessive profits found that:

1. Profits on sales for contract type were 18.3 for FP, 10.6 for FPIS, 8.8 on FPI, and 4.9 on CPIP.
2. Profits on net worth were 71.3% for the aircraft and missile contractors for which 67% of their contracts were incentive. Of particular interest are notes 21, 31, 39, 51, 62, and 95.

To close, let me quote Vinson, "I am fighting this because I know it (incentives) is costing the country a lot of money under the guise of efficiency."

11. ASPR Manual for Contract Pricing, DOD, US Govt., Assistant Secretary of Defense (I&L), Feb. 14, 1969, 150 pages.

This 1969 manual supersedes the manual of Oct. 1965. It is intended as a guide to be used in the pricing of contracts by government personnel in DOD. The book is divided into 18 sections. Like the original manual of 1965, it has a section on contract types (Section 2). Some 29 pages are devoted to a description of the contracts and their usage. Detailed graphs are provided;

and a discussion of their usage is intended to assist the buyer in the appropriate selection of the contract. The factors that are identified in the guide as important in contract selection are: 1. the incentive approach (to select a contract that will motivate the contractor to control costs), 2. the uncertainties in performance (type and complexity of the item, stability of design, the period of the contract performance, and the length of the production run), 3. the contract environment (extracontractual influences), 4. the accounting system (does it give you the necessary data for the contract type), and 5. negotiation (don't agree on contract type before the other terms and conditions are agreed to).

Of particular interest: by 1969 (the writing of this manual) the CPFF contract was described as intended for use in research, exploratory development, or in advanced development when the nature of the work required it. [The CPIF was to be used when a fixed price type could not be or when you did not want to use a CPFF.]

This document is very informative of the DOD's perspectives on the procurement policy of that period. It is particularly interesting when placed in the context of the Pre-1962 Monterey Conference policies.

12. Historical Development of Procurement Methods, Cox, Edward (Army) and Charles E. Jarrett (OSAD), DOD, 1970, 47 pages.

Government procurement methods include both advertising and negotiation. Historically the preferred method has been formal advertising. But in practice the DOD often purchases the large bulk of its weapons through negotiation. This paper written by two government employees both with a long record of government procurement experience traces the development of these procurement methods from 1792 to 1970. Each of the seventeen statutory exceptions

for the use of negotiation instead of advertising is discussed separately. This is an excellent reference for a general overview of government procurement methods and their use over the years.

13. Government Procurement Policy: A Survey of Strategies and Techniques.

Lenk, Barry R., Office of Naval Research, June 1977, 34 pages.

Mr. Lenk presents a discussion of the military procurement policies from 1947 to present. Alternative contract types are discussed with emphasis upon the allocation of risk between the contractor and the government. Strategies for the acquisition of major weapon systems are examined, and the impact of these strategies upon completion in the procurement process is considered. It is one of several references that provide an overview of contract types and acquisition policies.

III. Incentive Contracting Guides and Manuals

There have been relatively few manuals or training guides developed by the government or private industry for the training of their personnel in the theories of incentives. They include the two 1962 informal manuals provided by the Air Force School of Systems and Logistics for their personnel, the original Harbridge House Training Manual of that same year, the DOD Guide of 1965, the 1965 NASA Incentive Contracting Guide, and the 1968 Joint DOD/NASA Incentive Contracting Guides. Also included on a related topic is the NASA CPAP Guide of 1967. Non-government training manuals include those of The Contract Management Institute's which were commissioned by NASA for the training of their personnel, a manual written by Professor Ralph Nash of the George Washington University, and the training outline published by the American Marketing Association for use in their training course. In some instances individual government segments published material. For example, see "Stoics and Nomagraphy," developed and published by W. Hagen of the Marshall Space Flight Center (p. 25), and Major Gunn's "Synopsis and Guide" for use by Air Force Acquisition personnel (p. 28).

The guides are valuable on several counts:

1. They document the historical development of the policy and procedures,
2. They provide a tractable history of the intentions and objectives of the incentive contract, and
3. They use clues as to the perceived expectations in their use.

Taken together the manuals provide responses to most of the inquiries that we can raise about incentives. Whether we agree with the positions taken or the validity of the claims and reasoning is of course a different matter. And the objectives have changed over time. The intent of the early incentives

was apparently to assure performance while at least controlling cost. That is quite different from the implied intent of the current era of incentives. To appropriately evaluate the incentives we have to carefully consider the intent of the users.

Specifically, the guides provide information on policies, on profit levels, the appropriate contract for the estimated cost variation, appropriate incentive structures, a list of extracontractual influences, and value statement analysis. What was intended at the time to be guidance often ended up as gospel. Many of the contracts of the relative time period reflect the guidance "imposed in the guides."

1. Department of Defense Incentive Contracting Guide, Harbridge House, Boston, Mass., 1962, 51 pages.

This first DOD incentive contracting guide was prepared by Harvard's Dr. Sterling Livingston under the auspices of Harbridge House. It was very instrumental in establishing policy since it was used in the indoctrination course for 1800 Air Force contracting personnel as well as in the other DOD training of the time.

The guide was short compared to the later editions published by the DOD and NASA. It had seven parts: (1) The nature of incentives, (2) Cost incentives, (3) Schedule incentives, (4) Performance incentives, (5) Problems of multiple incentives and split responsibility, (6) Incentive contract management, and (7) Renegotiation of incentives. The guide is a rich source of the policy implications of the time. For example the fee swings associated with the different type contracts is explained as is the appropriate fee to be used for the target profits. These were:

1. Less than plus or minus 10% of target cost . . . Use FP
2. More than plus or minus 25% of target cost . . . Use CPPF
3. Between 10% and 15% . . . use FPI
4. From 15% to 25% . . . use CPIF
5. The appropriate fees for CPIF was 7% or 8%.
6. The appropriate fees for fixed price incentives was 10% or 11%.

Note is also made of the conflict between incentives and the policy of the renegotiation board. Incentives were still subject to renegotiation and the board was going to make sure that companies did not keep profits not really earned. Also the statutory limitations on fee ceilings were still applicable and influenced the design of incentives.

2. Fundamentals in Incentive Contracting in The Defense and Aerospace Industry, American Management Association, December, 1963, 42 pages.

This manual of lecture outlines was published by the American Management Association for a series of courses which it ran for industry and government personnel. These included talks from the following eight speakers. Their key comments are summarized below:

1. Mr. William Brant (Lockheed) talked about the incentive contract target price revision clauses of 7 Nov. 1962,
2. Professor Ralph Nash (George Washington University) spoke on the design and structuring of multiple incentives,
3. Mr. A. Lindsko (RCA) cited several administrative problems:
 - a. the definitization of letter contracts after contract performance had been substantially completed,
 - b. the refusal to adjust target cost on CPIF contracts where additional costs were the government's fault,

- c. government delays,
 - d. the refusal to write performance or schedule incentives,
 - e. inadequate program definition,
 - f. unattainable targets and goals, and
 - g. lack of detail specifications.
4. Mr. P. A. Huey (North American) spoke on the application of incentives to PERT. He covered Martin's Titan experience with cost, schedule, and performance incentives.
5. Mr. Francis Daigle (GE) spoke on the post-contract problems. These included: fiscal funding, CCN's, termination, changes in basic terms, disagreement on performance scoring, changes in personnel, final closeout, audit, proof of 100% contract fulfillment, the Renegotiation Board's attitude on incentives, punitive negotiations, successive squeezing of profits (Yesterday's performance becomes tomorrow's standard), the statistical game on percent of CPIF and CFPF, and the lowering of fee through negative fees.
6. Mr. Gordon Arthur (Air Force Chief of Pricing at AFSC) spoke of current happenings; what is good, what is bad, and what are the extra-contractual influences.
7. Mr. Gordon Tyler (NASA Chief of Procurement at the Goddard Space Center) spoke on incentive contracts for R&D. He said that the traditional multiple incentives were not well-suited. Therefore, they were experimenting with a new form--the CPAF. He reviewed and analyzed six incentive contracts; the FPI, the CPIF, the multiple CPIF, the FPI, the FPI multiple, and the CPAF. He also described several experiments. These included:

- a. options to convert from CPFF to CPIF or FPI,
- b. group incentives where two or more companies would share a common fee pool,
- c. self adjusting contracts where price would automatically adjust, and
- d. multiple incentives with various formulas fitting different phases of the effort.

8. Dr. John J. Kennedy (Department Head of Marketing, University of Notre Dame) spoke on the history of incentives, the design and analysis of incentives, the negotiation of incentives, overlap, iso-fee techniques, nomography, and the application of operations research techniques to their analysis and design.

This is a most interesting document. It contains valuable insight on the state of the art of incentives and the problems of that time period. Of particular note are the shortcomings that it highlights in the administration of incentives. And this was 1963. Many seem to remain in 1983.

3. NASA Incentive Contracting Seminar Manual, Harbridge House, Boston, Mass., NASA, 1966, 200 plus pages.

This manual describes a series of cases that was developed by Harbridge House for NASA as part of a training program run by Harbridge House for NASA personnel. In addition, the basic text for the course was the NASA incentive contracting guide. The course lasted five days. It centered around a series of cases and their analysis through the use of various graphical techniques including PIMM (Planned Interdependent Incentive Method). It is of historical interest because it contains the instruction that the NASA personnel received. For example . . . if the cases suggested that the target fee for

the CPFF were around six to eight percent, were these fees then regarded as the appropriate fees to use? The suspicion is that this is in fact what happened. The fee levels of most CPIF and FPI contracts are in 1982 the same as those suggested as appropriate in the early manuals.

4. Incentive Contracting in the Aerospace Industry, Kennedy, Nolan and Bass, Contract Management Institute for NASA, 1966.

This manual was used for training and as a reference manual for NASA contracting personnel. Courses were conducted at all the NASA Centers. Contracting Officers brought their contracts to the seminar; they were evaluated using the text material.

The manual is divided into six sections: 1. The history of incentives, 2. The rationale for the incentive contracts, 3. Some conceptual aspects of multiple incentives, 4. The design and analysis of incentive contracts, 5. Some legal aspects of incentives, and 6. An analysis of negotiation.

The contract for Ironsides in the Civil War and the 1908 Wright Brothers' Signal Corps contracts often are cited as early examples of incentives. And though these are early examples, incentive contracts were used extensively during World War I. The Bethlehem Steel, and the Dayton Airplane contracts are good examples. Also of note are the Burke and James and the J. J. Preiss company contracts. A rich source for such data can be found in the records of the Court of Claims. These World War I contracts were called bonus for savings contracts. Generally, in the court cases the bonus was allowed if specific contractor actions could be identified that resulted in the savings. And incentives were used widely during World War II under the name of target price contracts. In a 1943 article, Glenn Lloyd discusses the advantages and the disadvantages. Among the disadvantages was the problem of inflated

targets. In the post World War II period the incentive contract was used for large production contracts primarily as a Form C Redeterminable Contract. The CPFF was used for the procurement of development and for system acquisition.

The interest in incentives in the sixties seemed to stem from several factors:

1. The evidence that there had been greatly inaccurate estimates of costs and schedules under CPFF
2. the belief that under the incentive the contractor would be motivated to improve on these problems
3. the assumption that the government would improve its own estimates of costs and schedule,
4. the belief that the budgetary system would operate more effectively,
5. the assumption that the pricing of change orders would be more realistic
6. the belief that contractor efficiency would be improved
7. a disillusionment that accurate costing and timely deliveries could not be obtained through certain legal remedies such as liquidated damages
8. a long-standing feeling that the government had injected itself too far into contractor surveillance and that the incentive contract would result in less, and
9. a desire to motivate contractors to improve the quality of performance (as opposed to its cost).

The dissatisfaction with the CPFF contract also played a role. The Cost-plus-a-Percentage-Cost was used widely during the first World War. An inter-departmental board condemned it in 1917 and recommended the CPFF. Too often, the two types were often linked in the perception of contracting personnel.

The advantages of incentives cited were:

1. greater realism in negotiation
2. better statement of work
3. overall cost and frequency of changes reduced
4. cost efficiency and cost control (compared to CPFF)
5. lower prices (and higher profits)

The manual provides in Chapters Four and Five graphical analysis techniques for the negotiation of incentives. Chapter Six discusses the legal issues associated with such topics as renegotiation and profit limitations and provides a framework for the preparation for the conduct of negotiation. This manual should be reviewed by students of incentives.

5. Cost Plus Award Fee Contracting Guide (NPC 403), NASA, January 3, 1967, 103 pages.

Of interest particularly since it is a draft, this guide was intended to replace section NPC 403 of the NASA incentive contracting guide of January 18, 1965. The guide has seven parts: (1) Introduction, (2) Criteria and measurement, (3) Structure of the CPAF contract, (4) Organization and administration, (5) Cost plus award fee/cost plus incentive fee combination, (6) Summary, and (7) A study of the CPAF concept.

The guide as indicated in the chapter title is descriptive in nature. It describes how, when and where to apply CPAF type contracts. Of note is the proposed application: It was to serve some purpose other than the traditional contracts. "CPAF contracting is not appropriate for any procurement for which the firm fixed priced, the formula type fixed price incentive or the cost plus incentive fee types of contracts are suitable." Page 111. Also in section 7

on the theory of the CPA/ contract NASA dilutes the previous ASPR position that profit generally is the primary motive of business.

Seven interesting questions are raised that deal with the nature, extent and impact of other kinds of contractor motivations and their application to incentive contracts. It is an interesting discussion that reflects the growing concern in the middle sixties about profit being the only motivator. Each of the seven questions is discussed and applied to the query of how do we contract to harness contractor motivation.

6. Nomatics . . . Nomographic Aid to Incentive Contracts, W. Hagen, Executive Staff, Marshall Space Flight Center, March 1967, 33 pages.

The manual is divided into the treatment of three topics: (1) Nomatics applied to stoics (systemic techniques for the design of incentive) (2) Nomatics applied to traditional incentive contracting, and (3) Top management visibility. The book is filled with diagrams and charts throughout. It is an interesting approach for the design and evaluation of incentives. It also can be used effectively in the tracking of programs (Von Braun was disenchanted with traditional incentive methods and resisted their use. The author worked with Hagen in trying to develop methods that would be acceptable to the center).

7. 1968 Incentive Contracting Guide Summary, Kennedy, John J., Ph.D., University of Notre Dame, RCA, 1969, 21 pages.

This short paper summarizes the policies as described in the incentive guide of 1968 and provides the background of how they were developed and more importantly how they were being implemented. It was prepared for use by industry as a clarification of DOD's intent. Much of the 1968 guide appeared

to be arbitrary and vague as to specific application, this permitted considerable variation in interpretation. This document goes into detail on specific points in the design of incentives. For example, in multiple incentive contracts the objective should be cost control and not necessarily the lowest cost. Researchers who evaluate multiple incentives who fail to take this point into consideration can easily be misled into thinking that cost overruns means that the incentive has not worked. In fact often the contracts were designed to allow the contractor all the dollars to meet or exceed the performance and schedule incentives. This and similar points are explored in this paper.

8. Cost Plus Award Fee Contracting Guide, NHB 5104.4, NASA, August 1, 1967,
116 pages.

NHB 5104.4 superseded part seven of the NASA incentive contracting guide NPC 403. It is the final product of the draft of Jan. 3, 1967. Instead of the seven parts that were in the draft the official guide has four parts. These are: Introduction, CPAF Structure and Evaluation of Criteria, Organization and Administration, and Award Fee Examples. An appendix covers the CPAF theory.

In the introduction by Mr. George Vachetti of NASA, the appropriate usage of the CPAF contract is defined as that between the CPFF and CPIF contracts. This is consistent with the Draft, there the CPAF was applied to areas where the CPFF and the CPIF were not appropriate. As with the Draft, there is a discussion of the motivations of contractors and there is a recognition that the simple maximization of profit might not be appropriate.

The guide is a definitive source of NASA's recommended approach to the design and administration of the award fee incentive contract.

9. DOD Incentive Contracting Guide (draft), DOD, August 1968, 90 pages.

This draft is important as it provides rich history on the development of the guides and also provides an accurate picture of the conceptual foundations of the policy that existed at that time. It has ninety pages and eleven sections. In the preface it describes the history of the Guide. The original NASA and DOD guides were issued separately in 1962 at the urging of the Monterey Conference Committee. In 1963 a new DOD Guide based on contract definition and the use of multiple incentives expanded the thinking and application. The 65 DOD and NASA guides added considerably to the procedures and detailed instructions and expanded the use of multiple incentives; the NASA 67 Guide on CPAF Contracts developed the theory and application of the CPAF contract and was widely distributed among government and industry. The 1968 Guide was the first joint DOD/NASA book; it updated and modified the policies based on the experience of the services and the recommendations of industry and various study groups. The intent of the guide was to minimize complexity and to increase the effect of motivation. The contents were: (1) Introduction, (2) Incentives in pre-award procurement actions, (3) Incentive structuring, CPIP, (4) Incentive structuring, FPI, (5) Incentive contract negotiation, (6) Contract administration, (7) Cost plus fee, (8) Incentive services, (9) Exceptional methods of structuring, and (10) Extracontractual influences.

The extracontractual influences are of critical significance: The guide states that reward factors equal or nearly equal to profit are company growth (new fields of business), prestige (public image, social approval, national goals), opportunity for follow-on business (diversification or transformation to commercial business) and utilization of available skills and open capacity). These factors and their impact on the application of incentives is discussed at length.

10. Incentive Contracting: A Synopsis and Guide, Gunn, Kenneth C., Major, USAF, May 1974, 70 pages.

Major Gunn's objective was to develop a concise synopsis and guide on incentive contracting for use by program managers, contracting officers, and engineers to explain the theory, structure and pitfalls of incentive contracting arrangements. This guide is not intended to make an expert out of the reader nor is it written for the practicing expert. It is for the person who has only a limited knowledge of incentive contracting and desires to fill a void in that knowledge. The expert will find this guide too simplistic to be of value. Another purpose of the paper was to analyze the Missile System Incentive Contract that was prepared by students of the Defense System Management School.

There are five parts to the paper: (1) An introduction which covers the purpose and limitations, (2) The background of incentives, (3) The theory of incentives, (4) Structuring incentives and (5) Summary.

General advantages and disadvantages of incentives from the literature are discussed. He offers ten principles:

1. The contract structure should be simple.
2. The mission must be clearly defined and not subject to significant change.
3. Performance parameters outside the state of art should not be used.
4. Do not incentivize schedule or performance elements that have no value to the government.
5. Do not use incentives to assure a single performance parameter will be achieved. Do that in the specification.
6. Do not attempt to incentivize all possible performance parameters.
7. Be sure ranges of effectiveness are attainable and realistic.

8. Use cost only where there is only a minimum opportunity or need to improve performance or schedule.
9. Use the implied value technique.
10. Use life cycle cost systems effectiveness and critical initial operational criterion for assessing worth to the government.

It is concluded that incentive contracts are a useful tool and a technically correct way to acquire major weapon systems.

IV. The Selection of Contract Type

The appropriate contract type is central to this overall study. What are the conditions for the appropriate application of the various contractual arrangements? The answer lies partially in the variables in the procurement situation. Some clues should be found in the literature that identifies and isolates these factors for consideration. The articles and papers in this section do just that. For additional considerations, please also refer to the various contract manuals included in the references in section 3 of this document.

1. Air Force Guide to Contract Type, Air Materiel Command, 1958, 35 pages.

Types of contracts and the conditions for their use are described. Of specific relevance are the conditions that led to the use of the incentive. Also of significance are the statutory requirements for incentives in the U.S. Code Title Ten. The elements recommended for consideration in the selection of the contract type were:

1. Type and complexity of the item,
2. Urgency of the requirement,
3. Period of contract performance,
4. Length of production,
5. Degree of competition,
6. Difficulty in the estimation of costs,
7. Availability of comparative cost data,
8. Prior experience of the contractor,
9. Intent and nature of the subcontractor assumption of risk,
10. Technical capability,

11. Financial responsibility, and
12. The administrative costs to both parties.

Under Title Ten no incentive contract could be used unless it was first determined that the use of such a contract was likely to be less costly than other types of contracts and that it was improbable to secure the necessary services of supplies without the use of such a contract. The contracting officer was required by law to make such a determination and to provide same in writing to the General Accounting Office. A final point of interest: The author traces the increased use of cost contracts (from 12.7% in 1952 to 40.9% in 1959) to the increased complexity and technical nature of the end item.

2. Selection of Contract Type, Goddard Space Center, #0592647, April, 1961, 8 pages. .

The document developed by Goddard for its procurement personnel provides guidance on the appropriate contract type based on the procurement stage, the procurement situation, the range of uncertainty in the estimated costs and the item being procured. The recommended contract based on the cost uncertainty was:

Fixed price . . . plus or minus 3%
Fixed price incentive . . . plus or minus 10%
Fixed price incentive successive . . . plus or minus 10%
Cost plus incentive fee . . . plus or minus 15%

This is an interesting contrast to the range established in the incentive guide of 1962 which was quite different. These recommended cost variation ranges and the associated recommended fee ranges strongly influenced the profit rate negotiated under these types of contracts.

3. Army Chart of Contract Types, U.S. Army, 1961 (Original 57, Rev. 61),
Large Folding Chart.

The chart headings are contract type, description, special approvals required, advantages, disadvantages, special limitations, and remarks. The chart provides valuable insight into the attitudes and thinking of the Army in 1961. As to incentives, the chart indicates that they were not widely used by the Army but were used by the Navy in ship building contracts and by the Air Force for air frames. Also worth noting are the advantages and disadvantages stated for incentives. The advantages are that they encourage efficiency and the disadvantages (which greatly outnumber the advantages) were that (1) incentives required complicated accounting systems, (2) they increased the cost of administration, (3) the government assumed part of the risk, (4) it was difficult to establish the targets, and (5) they required experienced and honest contractors.

This chart was used in the training of contracting officers at the Fort Lee Procurement School. It was also used at the School of Systems and Logistics at Wright-Patterson AFB in the late 50's and early 60's.

4. Control of Production Unit Cost in Major Weapons System Acquisitions,

Kenyon, Peter B., Lieutenant Colonel, U.S. Army, February 1974, 57 pages.

The purpose of this paper is to examine the ways and means that the Department of Defense and its senior military and civilian program managers can achieve and maintain control of the production unit cost of major weapons systems. It is included in this section because it relates contract type to production unit costs.

This study examines a conceptual development and procurement program. It does so from the standpoint of various typical program objectives. Particular

emphasis is on those aspects of the program that can influence control over the unit production cost. It delineates the contractual requirements for both workscope (soft-ware) and data items. These are seen as necessary for both defense contractors and the government. They are required in order to establish a reasonable production unit cost goal. The study reviews various contemporary techniques that bear on the problem of controlling the unit production cost of large complex weapon systems. Further, it examines techniques that may be suitable to achieve better production unit cost control. Some of the additional techniques that are outlined include designing for productivity throughout the entire development cycle, the establishment of the working level of government contractor "trade off" teams, and changes to the procurement process including contracting methods and types of contracts during low rate initial production and subsequent follow-on full scale production.

Several techniques are presented and related in a diagram. These are:

1. Design to unit production costs,
2. Cost tracking,
3. Milestone tracking,
4. Award fee contracting,
5. Trade off teams, and
6. Firm fixed price contracting.

The article is interesting as a structured approach to an umbrella system for the assurance of getting a "good buy" and for illustrating the role of the contract type as part of the spectrum of techniques.

V. Characteristics of the Aerospace/Defense Industry

Incentive contracts may or may not work. Profit may or may not be the prime motivator of industry. That is the focus of this section. To fully comprehend the problem of the effectiveness of an incentive contract, or any contract for that matter, the contractual milieu must be examined. It is necessary to consider the uncontrollable factors as well as the controllable ones. It is necessary to look at the external factors that impinge on the behavior of the individual firm as well as delving into the bowels of the organization to find out what makes the company behave as it does. These external factors are explored in these papers. Each firm is part of a larger whole--the Defense-Aerospace Complex. To understand the firm we need to know something about the whole industry. Growth, stability, turnover, sales, investments, technological levels, employment and other factors are considered. See for example the works of Egan, Fletcher, Weidenbaum, and Mahoney for a start and quick review of the economics of the industry. Divita, Kennedy, and Roberts provide insight into the behavior of the firm and the customer. These again help us to understand the motivational patterns of the contractors. Many of these papers could easily have been included in the section on motivation. After reading these papers it would be difficult to still entertain the short-run profit argument as the primary motivation of a business.

1. Factors for Consideration in Obtaining Military Research and Development Contracts, Mahoney, Major John J., USAF, 1958, 210 pages.

Major John Mahoney studied the factors that were important in getting military contracts. The study was conducted primarily through questionnaires mailed to 282 companies and 147 government R&D personnel. He organized the

industry and government responses and compared them. An insight is provided into contractor motivation.

The study has four parts: (1) The problem of what factors industry and government think are important in obtaining military contracts, (2) A description of military R&D contracts, (3) The methods used in the survey, (4) Summary and conclusions.

The negative incentives were: (1) Low profits, (2) Lack of follow-on production assurance, (3) Government administration, (4) Lack of in-service coordination, (5) Delays in decisions, (6) Fewer opportunities for R&D work, (7) Lack of continuity, (8) Security requirements, (9) Difficulty in locating the proper people to work with, (10) High cost of personal selling and (11) Misunderstanding of the specifications.

The positive motivations were: (1) The chance to contribute to the national defense, (2) A way of enlarging the company's scientific staff, (3) Getting facilities and equipment, (4) Transference to commercial market, (5) Fair treatment by the government, and (6) The lack of the necessity of using influence in getting the business.

The most important factors in getting contracts were: (1) Company reputation, (2) Having high-grade technical personnel, (3) The ability to organize a group to meet schedules, (4) A sound approach to scientific problems, (5) A previous record of success, (6) Unique and original ideas, (7) Maintaining a close contact with the government, (8) Showing understanding of the problem, (9) Documented sound proposals, (10) Gearing the sales approach to the military need, (11) A sound financial condition, and (12) Stressing reliability and maintainability.

2. A Study of Contractors Proposal Efforts, Divita, S. F., 1960, 103 pages.

Divita's work is presented in five parts: (1) The research program, (2) General observations, (3) Findings, (4) Summary of findings, and (5) Conclusions. The purpose of the study was to study contractors proposal efforts to determine the process and to see what impact the inputs had on success. The study was conducted in conjunction with several members of the Harvard Business School. Eight case studies were conducted. The investigation was limited to the major proposal efforts associated with complex sub-systems. The companies invested substantial R&D and were mostly in the electronics area.

The process that produced the proposal is highlighted. For the student of incentives it has particular interest. It provides insight into a government contractor and it also demonstrates the many factors that enter into the determination of the bidding price other than cost.

3. A Survey of the National Association of Professional Contract Administrators, Marymore, J., Vice-President, NAPCA, Feb. 15, 1962, 83 pages.

Marymore's objective was to describe the nature of the job of the contract administrator. It is presented in three parts: 1. Background, 2. The survey, and 3. The conclusions. It includes the survey patterns by state, how contracts are assigned, the scope of activity, the education and training, the organization responsible for review of contract terms, the level at which contract policy is determined, the corporate areas to which contracts report, and how contract administration participates in the pricing function.

The survey consisted of 36 questions distributed to 520 defense contractors in 31 states. Replies were received from 88 companies. Two-thirds of the respondents were large and the balance small. The answers to the questions

are presented in tables. Taken together the data provides an interesting insight to many of the questions that relate to the effectiveness of incentive contracts. Insight as to the level of delegation and the nature of the internal administration of the contract once it is negotiated can be gleaned from the tables.

4. The Transferability of Defense Industry Resources to Civilian Use,

Weidenbaum, Murray L., Senior Economist, Stanford Research Institute,
November 21, 1963, 18 pages.

At the time that Professor Weidenbaum made this statement to the Senate, the country was concerned about maintaining the capability of the defense industry which was facing declining sales. The question that he addressed was the nature of the industry and its chances for successful diversification and the subsequent impact on the economy. The paper presents nine conclusions pertaining to the problems and the impact of transferability.

The paper was divided into an introduction, the specialized nature of defense resources, and the changes in public policy. The particular points of the article were:

1. Seventy-two percent of the value of the military prime contracts awarded in 1962 went to 100 companies and institutions. Of that amount seven major industries accounted for nine-tenths of the sales.
2. Fifty-six of the companies were in aircraft, missile, electronics.
3. Ten were petroleum and seven each are in automotive, ships, ammunition.
4. Five were construction and one a rifle manufacturer.

5. Research Program on the Organization and Management of R & D...How the U.S. Buys Research, Roberts, Edward B., MIT Sloan School #82, August 1964.

Professor Roberts studied the government R&D process for six years. On this particular study, he and his colleagues evaluated 41 DOD awards of eight-thousand to eight-million dollars and ten contracts from a non-defense agency ranging in size from one million to forty-million dollars. They interviewed a wide range of personnel directly involved in the award process and had freedom to review the agency files. Some of his findings were:

1. Awards usually go to the firms that are initially preferred by the government--even with the competitive system.
2. The real award process is one that involves a long term contract between the technical people in government and industry. On the basis of these relationship ideas are generated that eventually become requirements. The government tends to work the system to place the award with those they perceive as competent.
3. Similar to Scherer and Peck they found no evidence of political considerations playing a role even though they found a lot of political activity.
4. The costs of proposal efforts are very high (3% to 150% of direct cost of the contract awarded--Roberts, MIT Study). This costs money and time delays.
5. For R&D awards under 1 million, the government should be able to solicit industry informally to secure vendors.
6. At all levels of R&D the criteria should be the benefits versus the costs of a formal solicitation method. The costs of superficial competition may outweigh the benefits.

In this article Roberts makes reference to at least three other studies of the proposal process that were going on at that time at MIT.

6. Research and Development in Small Defense Firms: A Study in Marketing to the Government. Egan, Douglas McRae, Middle, 1960's, 270 pages.

Some insight into this study can be gained by considering the Table of Contents: (1) Introduction, (2) A profile of changing technology, (3) The character of aerospace industries, (4) Source selection, competition and small business, (5) Demand in technical markets, (6) Risk and R&D conduct, (7) The specification of variables and the choice of statistical tests, (8) The analysis of new product efforts, (9) Secondary factors affecting new product research, and (10) Summary and conclusions.

This dissertation provides a rich source of data to provide a basis for insight into the motivations and constraints of the aerospace manufacturers. It examined the nature of the markets; for example, the author studied the allocation by small firms of company research between new product opportunities and existing products. In Chapter I he draws a comparison between the normal market and the industrial military complex. In Part Two, Egan traced the changes in the magnitude and the sources of R&D funds. He highlights the role of the government in promotion and abetting technological change. Chapter Three outlined the aerospace market. Evident is the concentration in large firms. Also of note is the nature of the instruments of contractings that characterize the aerospace industry.

In Chapter 4 he highlighted the opportunity for firms to develop favored positions because of the uniqueness of their products and the nature of the administrative rather than economic selection. Chapter 5 dealt with the nature of demand. The uncertainties are unique due to sudden shifts in demand

from unanticipated technological environments and the uncertainty of the federal budgeting process. The magnitude of risk is greater than commercial markets. To reduce the risk the buyer and seller are closer than in the traditional markets of commercial products. Egan concluded through his analysis that: (1) The government oriented firms perform more new product research. In fact the government market is the most receptive buyer of new technology. (2) The demand is directed by the buyers and not the sellers. (3) Size alone is not a meaningful indicator of behavior as it relates to research. Technical flexibility is the means of gaining market acceptance. The real product of these companies is knowledge and scientific skill rather than excellence of manufacture. A dominant factor is the extent of the research effort. (4) The source for new ideas is dominated by the buyer--rather than internally generated as one might expect in commercial companies. (5) Some weight must be given to the size of firms and the intensity of the research in the determination of research allocations.

7. Defense Aerospace Marketing: A Model for Effective Action, Kennedy, Dr. John J., Chairman of Department of Marketing, Univ. of Notre Dame, Winter 1965, 9 pages.

The paper presents a conceptual approach to the nature of the marketing process within the aerospace firm and industry. It develops a model and then discusses the component parts. The organization of the paper is: A) Environmental factors, B) Weaknesses of marketing practices, C) Theory on organizational activities, and D) Guides to marketing practices.

The functional marketing activities are market intelligence, market planning, proposal formulation, customer relations, negotiations, and contracts.

Success in obtaining contracts is directly related to previous good performance, demand creation, the level of proposal sophistication, the cultivation of the decision channel, the expertise of the customer relations function, and the extent to which sound market planning has been undertaken based on marketing intelligence.

8. Marketing and Engineering Strategies for Winning R & D Contracts, Roberts, Edward B., Professor MIT, Sloan school, Paper #65, July, 1965, 25 pages.

This is one of several papers that resulted from the ongoing research program at MIT into marketing in the aerospace industry. This particular study addressed the characteristics of the successful bidder. The project reviewed contracts at DOD and NASA. The number of DOD contracts were 41 and 49 for the two groups studied; the NASA sample consisted of 10 contracts. The conclusions are of interest to the study of incentives because they provide insight into the organizational behavior of the industry-government relationship.

The results are similar to those reported in a prior Roberts paper published in August of 1964 on How the US Buys Research, and in fact is part of the same continuing study. The results were: (1) In the first phase of the award process many of the bidders are eliminated as not being technically competent. The ones left are often the companies originally recommended by the government. (2) Of the 49 cases studied, there were sixteen cases where only one contractor was deemed technically qualified. In thirty-five of the cases only two bidders qualified. (3) Of the remaining bidders the award went most often to the low bidder. (4) The technical initiator entered into the procurement process with a prospect already in his mind and he reflected this on his list of suggested bidders. (5) Non-bidders (those thrown out as not

feasible) are completely different than bidders in regards to fore-knowledge and customer contact. (6) The unsolicited proposal was a key factor in 32% of the rewards. (7) Whether the RPP was anticipated correlates highly with win or lose. (8) The award process is dominated by face-to-face, person-to-person contact, technical exchange, and the development of confidence.

9. Defense Marketing: A Model for Effective Action, Kennedy, Dr. John J., Chairman of Marketing Department, Univ. of Notre Dame, Dec. 15, 1965, 18 pages.

The purpose of the paper was to describe the nature of the defense industry and to develop a model for marketing. The paper was divided into several sections: 1. Environmental factors, 2. Weaknesses of defense-space marketing practices, 3. A conceptual model for defense marketing, and 4. Recommended practices.

The environmental factors were scope, dollar risk, created competition, the nature of the product, the research and development capability, change and obsolescence, an oligopolistic supply, a quasi-legalistic structure, and the political arena.

The weaknesses cited are: no marketing concept, shotgun proposals, speaking to yourself, loss of customer pulse, seat of the pants pricing, the contract firehose, and horsetrading.

The balance of the article outlines what the principal functions of an aerospace company should be: marketing intelligence, market planning, proposal formulation, customer relations, and negotiations and contracts. The article concludes with specific recommended marketing practices.

10. Defense Industry Diversification--An Analysis with 12 Case Studies,

Gilmore, John S. and Dean C. Coddington, Jan. 1966, 334 pages.

This document is a rich source of information on the aerospace industry's characteristics and statistics. It was commissioned to provide assistance to firms considering diversification due to the then severe cutbacks in DOD and NASA funding. In addition to the authors listed above Weidenbaum and Scherer were also associated with the project as consultants. Copies of articles by these authors are attached in the appendix.

The paper has two major parts. In part 1, the authors cover eight areas setting the background for the nature of the problem of diversification; and in part 2, they then summarize twelve cases of aerospace firms' attempts to diversify. Appendixes are provided for each section that are rich in data about defense industry firms' operations.

The eight sections of part 1 are: 1) Introduction to analysis, 2) Factors influencing diversification in the defense industry, 3) What kind of diversification, 4) Different approaches to acquisition, 5) Experiences of selected defense firms, 6) Conventional knowledge of defense firms about diversification, 7) Guidelines, and 8) The public interest in defense diversification.

Part Two has three sections: 1) The statistical background of the defense industry, 2) The twelve case studies, and 3) Five appendices containing articles by knowledgeable people in the field.

11. The Defense Industry Complex, Fletcher, Alec A., February, 1966, 42 pages.

This paper was prepared for the students of the School of Systems and Logistics for their study of the economics of the aerospace industry. It

covers demographic and economic parameters. The paper is divided into several parts as follows:

- A. In Introduction,
- B. Defense expenditures and gross national product,
- C. Breakdown of defense expenditures,
- D. The defense industry and industry generally,
- E. Effects on the country's economy,
- F. Research and development,
- G. Competition in the industry,
- H. Resources,
- I. Performance, cost, and schedule,
- J. The effect of past performance of awards,
- K. Weapon system management and the defense industry,
- L. Weapon system contracting,
- M. Small business,
- N. Incentives to enter the industry,
- O. The non-profits, and
- P. The future of the industry.

The development of defense firms from relatively small firms to places among the Fortune 500 had its beginnings in World War II. In 1939, no aircraft firms appeared in the list. By 1945 four were in the top 25. In 1963, 41 of the top 100 defense firms were also on the list of the top 100 of the Fortune 500. Since 1939, 195 companies have been represented in the top 100 defense firms.

Since World War II and the large production runs, the trend has been to greater complexity, smaller numbers, and a much larger proportion of the total

cost going to R&D. For example only 3% of the costs of the B-52 were allocated to R&D; for the B-70 the proportion is 30%.

This paper provides a valuable insight to the external macro forces that have to have a major influence on contract outcomes. It also suggests the difficulty of comparing contract outcomes for different time frames.

12. Strategies for Diversification of Defense/Space Companies, Weidenbaum, Murray L., Washington University, St. Louis, MO, June 21, 1967, 17 pages. Professor Weidenbaum discusses strategies for diversification by defense companies. The analysis is presented in five parts:

1. External Orientation, a macro picture of the industry including sales by customer and product group,
2. Targeting, setting goals and objectives,
3. Internal Orientation, a list of characteristics of the aerospace firm,
4. Development, the options for growth and a matrix of opportunities, and
5. Evaluation.

The particular characteristics of the firms are divided into the strengths and the weaknesses.

The strengths were:

1. The engineering, design and development capability,
2. The manufacturing capability for exotic materials and close tolerances,
3. The detailed knowledge of military/space markets and contractual procedures,
4. The unique systems management capability, and
5. The ability to bring together and work with a wide variety of firms.

The weaknesses were:

1. A lack of broad marketing and distribution capability,
2. A lack of experience on mass production,
3. A low capitalization relative to sales,
4. A lack of experience with military markets and products, and
5. Highly limited and specialized equipment.

13. Application of Design-to-Cost Concept to Major Weapon System

Acquisitions, U.S. General Accounting Office, June 1975, 22 pages.

This paper presents a General Accounting Office's review of the application of the 'design-to-cost' concept to major weapon system acquisitions. Weapon system acquisition costs had been increasing. The estimated unit cost of the latest generation of each of eight systems was estimated to run from one and a half to six times the cost of their predecessors. The cost increases would even be larger if they were to include inflation. Part of the cost had been for large-scale improvements in performance capability. The problem was that DOD had not been and would not be able to buy weapons in the quantities needed if this trend were to continue.

Design-to-cost had been in existence for about four years. None of the weapon systems to which it had been applied had yet resulted in much production. Therefore, it was too soon to know whether contractors would succeed in designing systems which would meet the performance objectives and, yet, could be produced at a cost within the goal established as a target. Much would depend on military program advocates not pressing for unnecessary sophistication, in the opinion of the GAO, to the extent that design-to-cost had brought about an increased cost consciousness. It offered excellent prospects for reducing the cost of acquiring new weapon systems.

14. Investment Policy for Cost Reduction, Bertrand, Harold E., Dr. Jean C. LaFrance, Dr. Henry J. Boisseau, Jr., and Anthony J. Provenzano, December 1976, 139 pages.

This report examines current investment opportunities for defense-related industries and the factors motivating capital investment, especially those related to cost reduction. DOD procurement policies that would motivate defense-related industries to make cost-reduction investment are recommended. The report contains capital investment case studies of four industries and a macroeconomic projection of defense industries' capital investment requirements. Two conclusions are:

- 1) Contractors invest in capital equipment either to gain contracts or to satisfy contractual obligations. Investment for the purpose of cost reduction apparently is hampered by some DOD procurement policies, procedures and practices.
- 2) Investment incentives are grouped into two categories. The first contains incentives already in the ASPR, which appear to require only broader application or minor change for immediate effect. The second comprises incentives that require substantial change in the ASPR, or congressional action, before they can be implemented.

15. Competition in High Technology Government Markets, Weidenbaum, Professor Murray, Dept. of Economics, Washington Univ., St. Louis, MO, Working Paper #6713, 23 pages.

This is another of Weidenbaum's papers on the economics of the aerospace industry. It is a very interesting paper. It is divided into four sections. These are:

1. Introduction: a description of the government market.
2. The Seller: concentration trends, size, distribution of awards, and importance of awards.
3. The Nature of Competition.
4. The Measure of Competition: types of competition (non-competitive, competitive), turnover among suppliers, concentration ratios, market concentration of Air Force procurement, value of shipments by category, and market character.

The conclusions were:

1. There are several unique characteristics of aerospace markets which include that they are monopolistic, and that the price is not always the determinate of sales. Also the technical capability is important, there is rapid obsolescence and the production which is not for inventory occurs after sales. Finally the bulk of the work done is oriented to the public requirements and not to market demands.
2. A relatively limited number of companies receive most of the contracts.
3. The leading 100 DOD and NASA firms is similar.
4. The medium size firms receive most of the awards.
5. Competition relates more often to technical competence than price.
6. An analysis of the top 25 firms in 1957 and 1967 in aerospace and non-aerospace indicates 21 of 25 are the same. Both have high stability.
7. Accepting that high concentration occurs when eight firms control 70% or more of the sales, the aerospace industry is concentrated in three sectors: aircraft, combat vehicles, and spares. Less stringent standards would indicate more cases of lesser competition.

8. On balance, statements so frequently made concerning the large degree of concentration and monopoly do not appear to be supported.

VI. Incentive Contracts Studies Empirical and Non-Empirical

This part includes most of the studies that have been made on the effectiveness of the incentive contract. In most instances the data sources were existing DOD or NASA contract records and interviews with industry and/or government personnel. Some of the studies are limited to a single Service.

Structurally the studies fall into two broad categories: First there are empirical studies based on hypotheses tested through statistical analysis of collected data, and secondly there are inductive-deductive studies which utilize some model or models to determine reasonably expected outcomes. The studies have been conducted by a hand full of people. Typically the researchers were associated with the government or the aerospace industry in some capacity. These included (1) the government procurement schools at Wright-Patterson Air Force Base, at Fort Lee, Virginia, at Fort McNair, Virginia, at Monterey, California, and at Carlisle, Pennsylvania; (2) The Think Tanks such as Rand, IDA and LMI; (3) Academicians at university-government funded research programs such as those at MIT, Harvard, and the universities in and around Washington, D.C.; (4) The Government Audit Agencies of a variety of kinds; and (5) University faculty associated in some fashion with the Aerospace Industry. The university researchers almost always came from institutions or universities that were among the top 100 DOD or NASA contractors.

It is always a risk to attempt to summarize a large body of research. And this case is no different. Any attempt would be biased by the selection process as well as by the researchers own predispositions and expectation set. The interested party is urged to review the individual synopsis to attempt to provide some synthesis of his or her own. However, certain issues came up again and again.

The question of efficiency was attacked in various ways. Mostly it was either through measuring the outputs of the contracts such as final cost and profits or measuring the impact on the economic utilization of company resources. I do not recall a single study that measured the quality or the effectiveness of the product itself. Perhaps that was because of the difficulty of such an approach.

Several of the studies attempted to summarize the literature to date. This might be a good place to start the review of this material. See for example, the study in LMI, Demong, Troy Jones or Ray Hunt. See also the impact of indirect costs in the work of Lynch and Pace.

1. Report to the Congress of the United States. Examination of Incentive Target Prices Under Department of the Air Force Fixed-Price Incentive Contracts with Lockheed Aircraft Corporation Georgia Division, The Comptroller General of the United States, May, 1959, 33 pages.

The misrepresentation of costs is a recurring theme, this investigation examined the estimated costs for subcontracted airframe components. These had been used in negotiating incentive target prices for an Air Force Fixed-Price Incentive Contract with The Lockheed Aircraft Corporation.

The comptroller concluded that since the contractor held firm quotations from subcontractors of prices lower than those represented as it anticipated costs, the use of higher estimates constituted an incorrect statement of costs to be incurred for the subcontracted airframe components. In addition, Lockheed should not have disclosed the major reduction in its quoted price of the empennage assemblies which occurred after the submission of its proposal. This reduction had been specifically brought to the attention of responsible Lockheed officials prior to completion of target price negotiations.

This study reveals but one of numerous practices that contribute to the questionable validity of target costs.

Since these overestimates were not disclosed by the Air Force's review of Lockheed proposals, they were not considered in negotiations and consequently the target costs were excessive. Unless an adjustment was made, the contractor would have received unearned incentive participations and target profits because of excessive target costs, rather than actual savings accomplished in performance of the contracts.

2. The Use of Incentive Contracts in Aircraft Procurement, Redden, Edward G., Lt. USN, 1965, 48 pages.

The Naval Postgraduate school paper reviews the theory and the practice of incentives through the analysis of the Navy's experience with incentive contracts. The paper has five parts: 1. Introduction, 2. Background and application, 3. Discussion and conclusions, 4. Recommendations, and 5. Bibliography.

The conclusions and recommendations are:

1. Policies and procedures have to be changed if incentive contracts are to attain a high degree of effectiveness.
2. The willingness of a contractor to accept an incentive is a function of the contractors business volume and his financial status.
3. The benefits of incentives go beyond the normal goal of effectiveness of costs.
4. Profit potentials that motivate the contractor must be established.
5. Targets must be realistic and mutually decided upon.
6. The later a contract is definitized the harder it is to establish effective incentives.

7. Evaluate contractor performance periodically, not just at the end of the contract.
8. The farther down the organization the incentives are applied, the more effective they are likely to be.
9. The award fee contract is not considered feasible for general employment in aircraft procurement due to the arbitrary nature of the award and the absence of known incentives during the procurement process.
10. Design and specification changes are a major detriment to the effective use of contractual incentives.
11. Another stumbling block is the award policy. Fees are not high enough to motivate and the penalties are not great enough to provide adequate protection against poor performance. The rigidity of current profit levels must be relaxed.
12. The renegotiation board proceedings have also limited the effects of incentive.
13. The area of subcontracting has become paramount and should be considered in the structure of the incentive.
14. Performance incentives need to be improved by including maintainability and the overall performance of the end item.
15. Schedule incentives should emphasize positive rather than negative factors.
16. The basing of profits on costs that are hard to estimate and that continually change over the contract accounted for the majority of the criticisms against incentive contracts.
17. The contractor's disutility for cost savings can negate the incentive. He may use increased costs to improve his facilities, to cover

overhead from other projects, or improve his product to be more competitive for follow-ons.

18. Cost audits should be based on direct costing rather than absorption costing.
19. Regardless of the methods employed in the utilization of incentive contracts, extreme care should be taken to insure that governments controls over contractor operations are kept to a minimum.

3. Contractor Decision Making and Incentive Fees Contracts, Bradley, C. E., C. C. McCuiston, December 1965, 29 pages.

The objectives were to identify and analyze NASA's present and emerging policy problems. They conclude:

1. The contractor is not greatly motivated by the prospect of a fee greater than that which he considers "fair,"
2. The incentive contract philosophy incorporates the explicit assumption that contractors can and will significantly control their costs to participate in the incentive "rewards" for efficiency. The possibilities for controlling the cost outcomes are insignificant in comparison to the cost uncertainties associated with incentive contracts. Therefore the contractor seeks the most desirable position in terms of the uncertainties of the cost outcome. This position does not coincide with the negotiations of high sharing fractions and wide fee swings--terms which would be a significant inducement to the contractor to hold costs down.
3. The contractor has an excellent opportunity with incentive contracts to negotiate an arrangement which will provide for a greater utility than that of a CPFF contract.

4. Tight target costs are completely incompatible with the negotiations of strong incentive provisions. Assuming that the target costs are reasonably tight on the average there is a definite indication that sharing fractions larger than those now being negotiated would result in incentive contracts with greater risk than PFF contracts--unless the target fee is considerably greater than the legal limits.
5. Furthermore, there appears to be little inducement for the government contract negotiator to negotiate sharing arrangements which would provide a significant inducement for the contractors. In fact, it is usually to their (Contracting Officer) advantage to negotiate moderate to small sharing arrangements.
6. Incentive contracts have an advantage of flexibility in the fee arrangement. This assumes that this attribute is a rational and desirable objective.
7. Despite certain past criticism, the incentive contract has the quasi-theoretical facade of promoting efficiency through a basic appeal to the profit motive.
8. The method of pricing cost-plus contracts can result in a greater fee for overruns than for underruns. This is a significant factor to consider if one is designing a fee schedule to appeal to a short-run profit motivation. However, if contractors are oriented towards the short-run profit rewards, one would expect a greater number of cost overruns on incentive contracts than are presently indicated by the data. Therefore, there is reason to believe that the contractors are generally unconcerned about the marginal aspects of the fee situation, or that they are more concerned with the positive benefits to their long-run sales associated with a reputation of achieving targets.

9. There is little potential for negotiating fee arrangements which would stimulate contractor efficiency. The author believes that the contractor's performance can be better controlled through some organized method of contractor performance evaluation, and through inducements directed at long-run rather than short-run interests of the contractor.

4. Summary of Booz-Allen Study of Incentive Contracts, NASA-In House Document, September 15, 1966.

The Booz-Allen study took thirteen and a half months and five man years of effort to complete. The sample size represented 62% of the contract dollars. But the sample size and the number of contracts were too few in the opinion of the authors to develop statistically reliable outcomes. It contains over 900 pages of case studies.

The findings were:

1. The effectiveness of incentives is largely dependent on the program definition at the stage that the incentive was introduced.
2. Incentive contracting has resulted in better program definition.
3. The use of incentives has resulted in improved communication between the contractor and NASA.
4. The full utilization of the benefits of incentives would require changes to the current policies.
5. Deficiencies in current contracts included:
 - a. The sharing arrangements were too shallow.
 - b. The sharing ranges were inappropriate.
 - c. The weights among the variables were inappropriate.
 - d. The band of incentive effectiveness was too narrow.

- e. The performance incentives included weight on the final element without use of subgoals.
- f. Incentives were used inappropriately when numerous changes were contemplated.
- g. The study indicated no actual tradeoff among the variables.
6. The effectiveness does not seem to be related to the amount of fee but rather to the clarity and the objectivity of the structure to the incentive rewards. There was evidence of effective use of schedule and performance incentives.
7. The earlier contracts were not accompanied by adequate administrative feedback to permit tradeoff decisions. The lack of visibility on changes and cost impacts do not permit tradeoffs.
8. Extracontractual influences can be much stronger than profit.
Multiple incentives are more effective than single ones.
9. The effectiveness of the incentive varies with the slope of the share line.
10. Contractor's management do not communicate details of the incentives to motivate the working level personnel. The exception is performance incentives which were used to motivate supervisory personnel.
11. The effectiveness of performance and schedule incentives bore little or no relationship to the dollar value of the incentives.
12. Incentives have resulted in a better discipline concerning changes than existed under CPPF contracts.
13. The overrun of major subcontracts were found to be a major cause of prime overruns.
14. The basic benefits of the CPIF contracts were largely a result of the systematic monitoring and evaluation processes.

5. Cost Incentives and Contract Outcomes, Fisher, Irving N., September 1966, 55 pages.

Fisher statistically analyzed 525 Air Force randomly selected contracts that contained 90 FPI and CPIF incentive type contracts. The purpose of the analysis was to evaluate the effectiveness of the incentive contract. It is a comprehensive study that manipulates 18 variables through factor analysis and statistical tests. He concludes broadly that there are 4 major influences: (1) The contract size, (2) The contract risk, (3) Cost of performance, and (4) Changes.

The study is presented in 5 sections: (1) Introduction, which presents the background of incentives, (2) The survey of recent contract cost outcome experiences, where he talks about the summary statistics and the influence of project characteristics, (3) Incentive pricing arrangements where profit rates, share rates, and effect of project characteristics relationships are discussed, (4) Incentive contract cost outcomes in which are discussed the incentive effects, cost outcomes, and changes, and (5) Conclusions. Two appendices discuss underlying dimensions of incentive contract outcomes and factor analysis.

6. Notes on Incentive Contracts, Deavers, K. L., J. J. McCall, September 1966, 35 pages.

Deavers and McCall analyzed 252 AF contracts for two time periods: 1959-62 (126) and 1962-63 (126). Outcomes differed over the two periods. The authors concluded that factors influencing contract outcomes are very complex and that a more complete study was in order to relate theory and practice.

This relatively short paper includes sections of introduction, risk and incentive contracts, the empirical analysis, and conclusions. In the

empirical analysis, they address the initial cost estimates, the adjusted cost estimates, the influence of contract size, the relation between initial and adjusted cost estimates and contract growth.

The conclusions were:

1. The effects of incentives have two components. The efficiency effect and the risk effect. These are intertwined in all incentive arrangements. Data collected does not permit distinguishing between these.
2. For the period '62-'63 there was no statistical evidence that high shares were more efficient or more risky. Differences between estimated and actual costs did not vary with the share rate.
3. For the period '59-'6, the results were different. The differences between estimated and actual costs become increasingly negative with increasing sharing rate.
4. The above suggest that these differences were caused by changes in contractor/government behavior.

7. Reappraisal of Cost Incentives in Defense Contracts, Cross, John.
September 1966, 34 pages.

Cross' analysis is primarily concerned with the impact that incentive contracts had on contractor efficiency and the extent to which overruns and underruns were a reflection of that efficiency. The paper presents eight interpretations related to that alleged 10% savings postulated by the Secretary of Defense and tests them against several sets of data from aggregate DOD contracts selected from the time period 1953 to 1965. For example . . . "The inclusion of fixed overheads in basic contract costs tend to induce contractors to shift costs from high to low sharing rate contracts, it is easier to

induce firms to accept high sharing rates in less risky contracts, and if firms do accept high risk in contracts they will tend to charge for it."

The major conclusions were:

1. Incentive contract payments for risk bearing exceed the benefits derived as reflected in increased efficiency.
2. The popularity of incentive contracts is more easily explained by the sub-optimizing behavior of individual procurement officers than it is in terms of the objectives of the organization as a whole.
3. Target costs are strongly influenced by other features of the contract. Insofar as target costs are raised as sharing ratios are raised the efficiency in contract performance is overstated.
4. Target price is not a good variable on which to select a contractor.
5. Cost incentive contracts do not assure selection of more efficient contractors.
6. One could do just as well by replacing FPI contracts with CPFF and then selecting the contractor with the lowest fee.
7. Performance incentives do have merit. They provide additional flexibility and tend to reduce the risk.
8. Cost incentives are probably not very effective. Firms usually achieve efficiency by institutionalizing it over time through new devices introduced into the existing routine. In the short run opportunities for cost control are too nebulous to seriously influence the incentive provisions. If the time periods for contract performance were long the incentive provisions might be more effective.

8. Observations on Incentive Contracts, Hill, Walter. Assistant Professor, Syracuse University Special Projects Office, Dept. of the Navy, 1966, 45 pages.

This summary report of the work done during the summer of 1966 for the Naval Special Projects Office includes conclusions, recommendations, methodology, discussion, and acknowledgements. To compile the study, the author conducted interviews with both government and industry personnel. This included staff personnel from three large weapon system organizations. Ten contracts ranging in size from 5 to 100 million dollars were examined. Limitations were noted relative to the validity of the conclusions stemming from the small sample size and the nature of the interview techniques. The report is broad in its inquiries and provides a range of conclusions and recommendations.

1. The assumption that contractors attempt to maximize profit on every contract is invalid. Mathematically imprecise approaches, the training on incentives that distorts the importance of short run profit, and the assumption that a contractor is motivated by a single invariant objective are suspect.

2. Contractors possess many goals. The motivational mix might vary from contract to contract and also within a given contract over time. Also differences exist between the government and the contractor on what the motivators are.

3. Extracontractual factors are important considerations in the determination of contractor behavior. These include at least public image, organizational prestige, commercial spinoff, and improved market position. In practice these factors are largely neglected.

4. Firms seek long run satisfactory profits. The upper limit is defined by concern for the GAO and the renegotiation board. The lower limit is defined by competitive factors. The size of the contract and the negotiated fee have more importance on behavior than the structure of the incentives.

5. Contractors attempt to insure satisfactory profits at the bargaining table when the contract is negotiated. When a contract mix is available the contractor has a tendency to lump personnel and overhead costs on the CPPF contracts. This encourages and results in CPPF overruns.

6. Firms place great emphasis on attaining and meeting performance and schedule commitments to enhance reputation. Few firms deviate from this. Firms in some instances trade off cost and schedule to assure performance. Where a negotiated profit level is adequate firms might engage in the trade-off activity. The achievement of maximum incentives for delivery may be assured by overly pessimistic delivery schedules.

7. The assumption that contractor behavior is independent of his contract mix is fallacious.

8. Contractor behavior is constrained by the GAO and the renegotiation board. Excessive profits result primarily from cost uncertainty. Contractors cannot offset potentially large losses with high gains. The agencies have the impact of constraining the fee level and constraining the nature of competition.

9. The training in multiple incentives is invalid but achieves better contract definition, improved work statements, and improved reasonableness of target costs.

10. Contracting officers are too conservative in providing cost incentive opportunities to the contractors: Cost share ratios are too low and target costs too tight because the contracting officers feel they might be viewed

as poor negotiators. And they are inadequately trained in cost estimating and cost accounting. The government is at a disadvantage at the negotiation table.

11. Subcontracts are inadequately administered. Plant representatives are inflexible and may possess an audit bias. They check if an operation has or has not been performed and not whether it should be.

12. Communication among the government agencies on incentive contracting experience is seriously deficient.

The recommendations are:

1. Investigate what motivates contractors.
2. An across-the-board committee should study the various questions raised.
3. A special project office should be established of trained capable personnel to handle the negotiations of major contracts.
4. The DOD and NASA guides need revision: (a) recognize the validity of multiple influences on the contractor, (b) de-emphasize the use of multiple incentive on R&D contracts, (c) spend more time on target costs analysis, (d) spend more time on project definition and the need for coordination between technical and administrative personnel, and finally (e) spend more time on contract administrative procedures.
5. Define and explain the functions of the GAO and the renegotiation board.
6. Develop analytical techniques for dealing with the multiple contract-mix environments.
7. Reduce and change the training on multiple incentives: high shares should be employed particularly on the overrun side, a smaller range of

incentive effectiveness should be used, the size of the target fees should be reduced, and the magnitude of the fee swings should be increased.

8. Discontinue the renegotiation board.

9. Follow appropriate channels of communication in government-industry communications, and

10. Authorize and use CAPF contracts more; only this type of contract offers the government the combined benefits of an incentive for better performance and flexibility.

9. How to Build a Better Contract, Chemical Week, April 1, 1967, 2 pages.

The byline gives a good idea of this article's content: "Government looks for ways to make sure its carrot or stick contracts give it the best deal." Chemical Week summarized the studies of incentive contracts and gives a synopsis of their findings. The major issues centered around several propositions. These were:

1. Secretary McNamara reduced CPFF contracts from 38% to 10%
2. extracontractual factors may play a more significant role than profit in motivating contractors,
3. the contractor will do whatever is necessary to gain a long production run,
4. the long production run will win the enviable position of being the only supplier,
5. the contractor may perform well on one contract to be favorably considered for the next, and
6. the contractor may make sizable expenditures as a means of staying in the technological forefront.

The studies addressed these queries. The results were summarized.

1. A Perry Pratt headed Science Board Study found that:
 - a. Cost incentives do not tend to degrade performance, and
 - b. Where properly applied bonus deals are better than CPFF deals.
 2. A Booz-Allen and Hamilton study concluded the same.
 3. A Rand Study said:
 - a. There is a question whether higher sharing rates actually induced the contractor (a) to be more efficient or (b) to accept greater risk by agreeing to lower target costs.
 - b. the effectiveness of the more complex incentive arrangement is questionable.
 4. An Institute for Defense Analysis study concluded that:
 - a. The premium paid to contractors under incentive contracts has exceeded any savings obtained from the increased efficiency, and
 - b. the calculations of increased efficiency are likely to be overly optimistic.
 5. The DOD and NASA in their studies concluded:
 - a. The sample of the studies have been too small (Cravens of NASA),
and
 - b. Contractors are not reaping the benefits due to poor subcontract management (Cravens of NASA).
10. An Analysis of Contractual Incentives, Berhold, Marvin, September 1967, 160 pages.

Berhold applies an analytical framework from decision theory to the analysis of incentive contracts. Data from several large government contractors are used to estimate the utility function of the contractor. Three

classes of utility functions are considered: exponential, gaussian and quadratic. From these utility functions, the author derives the target profit as a function of the sharing ratio. A general model of contractual incentives is developed.

The dissertation is divided into six sections:

1. an introduction to contractual incentives,
2. a model of government incentive contracts,
3. an illustration of the model of incentive contracts,
4. a note on the bargaining implications of the incentive model,
5. a general model of incentive contracts, and
6. other applications and future research topics.

Summarizing:

1. The model concerns itself with the contractor selecting an optimal production method subsequent to the time when the contract is specified.
2. The question is how to motivate the contractor to accept the contract and to subsequently choose a production method to minimize costs.
3. The government is assumed to have a linear utility function. The contractor's utility function is estimated from contractor and government data. Implications on overhead are considered in addition to resource allocation and risk.
4. The primary recommendation is to implement direct charge incentives. Another is to negotiate overhead as a separate single contract with its own share ratio, target profit and target cost.
5. Cost estimates have to be improved to reduce the variance and therefore the risk.

6. The government should increase the share ratio until the marginal increase in the target profit is equal to the marginal decrease in target cost.
7. CPFF contracts should not be considered zero risk contracts. In the final section he addresses the application of the model to psychology, political theory, economics, and management.

11. Defense Industry Profit Review: Volume I, LMI, Washington, D.C.

(Logistics Management Institute), November 1967, 135 pages.

This LMI study is Part I of a 2 volume set on profitability in the defense industry. One hundred and ten companies were contacted; of these sixty-three participated in the study. The firms were broken into three categories of high, medium and low volume and compared with data from six durable goods categories of the non-defense industry.

During the early 1960's the DOD implemented several policies that should have increased the risks of the defense/aerospace industry. These were:

1. Shifting from cost plus fixed fee to incentive contracts,
2. The shift from cost to fixed price contracts,
3. The reduction of the provision of facilities, and
4. The initiation of the contractor performance evaluation system.

During this same time period the renegotiation board reported a drop in the pre-tax earnings on sales from 6.5 percent in 1956 to 3.1 percent in 1962. Profits went down instead of going up to reflect the increased risk. Then in 1964 the DOD promulgated a profit policy which recognized the importance of profits as a means of assuring a fit defense industry. The intent of this LMI study was to gather adequate data to make a meaningful assessment of the profit picture. Profit data was collected for the years 1958 to 1966.

The study was presented in two parts. Volume I describes the format of the study, the analysis and the results. Volume II presents the supporting data. The contents of Volume I are: (1) Summary Findings, (2) Profit/Capital Investment ratios and capital investment turnover, (3) Profit/Sales ratios, (4) The Department of Defense profit review system, (5) Unrecoverable and non-recoverable costs, (6) Capital market analysis, (7) Discussions with defense industry personnel, and (8) Observations, conclusions and future plans.

The profits on incentive contracts by type for the 1,842 contracts studied ('58 through '63) show that the profits were:

FPI 9.2% of costs and 8.4% of sales

CPIP 7.2% of costs and 6.7% of sales

CPFP 6.1% of costs and 5.7% of sales

The reasons that defense profits were lower than commercial profits as derived from industry interviews were: the severity of competition, the higher degree of unpriced risks, the lower contractor profit objectives, inadequate specifications, the buy in, overcapacity, and the government bargaining position. The level of profits on fixed price contracts were lower than expected due to estimating, increased competition, and the increased volume of development work.

The industry complaints were:

1. There were gaps in the implementation policy at the operating level,
2. DOD does not diminish controls in high risk areas,
3. The costs of proposal preparation are increasing rapidly,
4. There are time delays in consummating contracts,
5. They were not being kept informed in a timely fashion,
6. There was premature price competition on complex items,

7. There was an attempt to enforce conformity in the management of the firms,
8. There was an increase of unallowable and unrecoverable costs,
9. Overhead rates developed for cost type contracts were being applied to fixed price negotiations,
10. The requirement to invest in facilities has not been accompanied with increased profits associated therewith,
11. The competitive advantages of those companies that have been given government facilities is unfair.
12. There is a high cost to subcontractors for preparing initial and subsequent proposals because of re-solicitation.

The conclusions were:

1. In 1958 over 70% of the contractor's business was defense. Now it is less than one-half. Over 60% of their profits came from defense . . . now over sixty percent come from commercial business. On Profit the trend has been down when compared with the commercial sector.
2. The weighted guidelines method has resulted in some inequities. Contractor investment needs to be given greater weight.
3. Capital requirements have increased more rapidly than defense sales. Progress payments should reflect the shift in contract types in recent years to incentives and fixed price.
4. Forty percent of the unallowable and nonrecoverable costs are for disallowed R&D. LMI endorses a policy to provide relief.
5. Fixed price contracts and competition have increased. Improved criteria should be provided DOD personnel for the use of firm fixed price contracts. There has been so much emphasis on FFP that this type of contract has been used injudiciously.

12. A Study of Selective Aspects of the Use of Incentive Contracts in the United States Air Force Procurement Management, Jones, Troy, Col., USAF, 1967, 201 pages.

Jones did a very comprehensive Empirical analysis of a broad sample of Air Force contracts of the 1963-64 period. His study sample included 53 weapon support systems and/or production contracts. It included a cross-section of Air Force weapon end items (missile, airframes, electronics, etc.). The study includes: (1) Introduction, (2) The weapon acquisition process, (3) Incentive contract theory and policy, (4) An analysis of selected Air Force contracts, (5) Implications of quantitative findings, (6) Effectiveness of performance, (7) Qualitative evidence from the case studies, (8) Conclusions, recommendations and the bibliography. Some fifty-one tables, and five illustrations are included.

He lists eight specific issues that the dissertation pursues. These were (1) Is there any significant difference in average variations from target costs in different types of contracts? (2) Is there any significant difference in target costs among different contractors performing under like types of contracts? (3) Is there a statistically significant difference in final variations in target cost between contracts for development and contracts for production? (4) Is there any correlation between the contract sharing ratios and the variations of final costs? (5) Is there a significant difference in dispersion of individual percentage variations of final costs to target costs? (6) Is there a significant difference in average percentage changes in scope from all types of contracts? (7) Is there a significant difference in average final variations from target costs in a set of contracts which have incentives on both performance and cost dimensions as compared to those sets of contracts which have incentives on the cost dimension only? and (8) Is

there a significant difference in original or final average profit rates among types of contracts?

There are three general questions. (1) Have cost incentives generally been effective? (2) Have performance incentives been generally effective? (3) Have trade-offs been made between cost, schedule and performance incentives that have proven to be detrimental to the Air Force.

His conclusions were:

(1) Little or no statistical correlation exists among contract share and cost outcomes: (a) A regression analysis showed no significant correlation between the magnitude of individual contract cost sharing ratios and the cost outcomes, (b) However, when contracts were divided in two groups, one with high and one with low cost sharing ratios, the deviation of cost outcomes of contracts with high cost sharing ratios is significantly smaller.

(2) Cost incentives are not highly effective in preventing cost growth. Cost overruns or changes in the contract are due primarily to technological uncertainty. When appropriate groupings were made to eliminate differences resulting from different purposes of the contract, i.e., the contracts for development vs. contracts for production or level of completion of contracts, there was no significant difference of cost outcomes among CPFF, CPIF or FPIF type contracts. He suggests that the level of technical uncertainty within a program continues to play a much stronger role in cost outcomes than the type of contract under which the program is conducted.

(3) Jones found that when adjustments had been made to remove the effect of scope changes that merely represented an extension of the yearly contracts or the like, that there was no significant difference in average percentage changes in scope between CPFF and CPIF contracts. However it was found that

there was significant correlation between the magnitude of cost overruns and the magnitude of changes-in-scope of incentive contracts.

(4) The findings suggest that there is inherently a greater discipline for control of changes-in-scope under incentives than under CPFF.

(5) Technological uncertainty greatly affects the degree to which contracts respond to incentives. This subject should provide an area for much more fruitful research than that found in the further study of the structure of incentives.

(6) It was concluded that performance incentives are not effective in controlling the cost of weapons performance. In each of the examined contracts which contained performance incentives where the contractor came close to target he lost more on the cost incentive than he gained on the performance incentive. This finding suggests that extra-contractual incentives such as the need to be known as a high quality producer, or the opportunity for greater profits in subsequent production contracts, played a larger part in achieving the desired performance level rather than the contractual incentives. Performance incentives do provide some motivation that is above and beyond the additional profit available by the attainment of the incentive goal.

(7) The effectiveness of performance incentives appears to bear little relationship to the amount of additional profit available by their attainment.

(8) Multiple incentives lack the greater visibility and ease of administration of simpler incentives.

(9) There is no indication that contractors have ever attempted to make precise trade-offs that are finely tuned to variations under incentives. And since, at the early program stages, there exists a technological uncertainty, the emphasis is nearly always on meeting target performance goals rather than in surpassing them.

(10) If potential performance and cost outcomes are so uncertain, cost contracts must be used instead of an FPIP. Performance incentives should not be used.

(11) Whenever performance incentives were used, cost overruns were much greater since the contractors traded off profits from cost overruns in order to surpass performance goals.

(12) Although the problem of technological uncertainty in weapons development has been studied and tentative methods for estimating its magnitude have been suggested techniques for accurately estimating its impact on total systems cost are far from satisfactory.

(13) Performance incentives tend to provide some additional motivation by creating a more stimulating atmosphere and providing more visible goals for managers, engineers, and project personnel.

(14) At the present time results under PIIM do not appear superior and the method should be discouraged.

(15) Performance incentives should not be used with CPIF contracts but only with FPI contracts. The ceiling price of the FPI contracts provide an effective limit against undesirable trade-offs.

(16) Schedule incentives can be very effective incentives because they can be made visible to the factory workers. They are easily understood and the progress toward goals can be relatively easily measured.

(17) The use of incentive contracts have resulted in better contractual discipline by the Air Force with regard to time reaction and other decisions required during contract performance.

(18) Incentive contracts have exerted some motivation on the contractor to improve his organizational structures.

(19) There has been some tendency by the Air Force to overreact to the current emphasis on incentive contracts by the Office of the Secretary of Defense.

13. An Examination of the Foundations of Incentive Contracting, Logistics Management Institute, Task 66-7, May 1968, 28 pages.

LMI's paper has sixteen sections. It compares the goals of incentives as described in government publications and policy documents with the results as provided by a variety of studies. Then through a deductive, intuitive analysis it lists several conclusions and observations.

Incentive contract studies to date have: 1. concentrated heavily on contract results, 2. failed to consider other factors affecting decisions, 3. neglected the influence that environmental conditions have on the difference between stated objectives and final outcomes, and 4. focused on poorly structured contracts. The most common deficiency is that the prior studies do not consider incentive contracts in the total perspective of their environment. The key question is what is motivating the contractor.

It is widely recognized, say the authors, that contractor motivations include: 1. company growth, 2. increased share of the company market, 3. better public image, 4. organizational prestige, 5. carry over benefits, 6. greater opportunity for follow-up business, and 7. greater shareholder expectation for future growth and profit. Also it is not unusual for a company to intentionally take a loss to: (1) gain competitive advantage by engaging in developmental efforts, (2) acquire or retain competent personnel, (3) spread fixed cost over a substantially larger base, and (4) prevent a potential competitor from gaining a foothold in the market. Also the personal goals of the management are important. The remuneration of managers as well as their

prestige and reputation is more dependent on sales growth, market share, and survival rather than profit.

LMI mentions six studies: 1. The Booz-Allen Study, 2. The Defense Science Board study, 3. Dr. Cherington's study, 4. Professor Hill's study, 5. Colonel Troy Jones' study and 6. the Scherer study. These studies provide seven general criticisms and four favorable aspects about incentive contracts. The six studies mentioned agree on the following seven points:

(1) incentives do not work to the disadvantage of the government except in administrative cost, (2) when a contractor discovers that his incentive arrangement does not correspond to his interests, he ignores the incentive, (3) incentives serve as a planning discipline for personnel, (4) requirements are more thorough and the work statement is more precise, (5) incentive structures clearly communicate the government's objectives to the contractor, (6) they attract the attention of management, and (7) when it is possible to associate activities of individuals with specific contracts, incentives provide a useful tool for motivating workers.

In summary (1) there is no compelling evidence that cost incentives are working, (2) performance incentives may be unnecessary, (3) incentives have resulted in better planning and more precise communication of goals, (4) during most of the contract life, the contractor is not in a position to make trade-offs on major decisions, and (5) the potential to use incentives for trade-offs is highly over rated.

The recommendations of LMI are:

1. Use contract definition in all development programs.
2. Discontinue the use of performance incentives in development contracts.

3. Employ cost incentives on systems development contracts whenever contractors will accept some cost risk, yet will not accept fixed price contracts.
4. Use schedule incentives in engineering and operational system development contracts only when the delay in work completion is of substantial consequence, yet is tolerable.
5. Make use of value analysis and performance ranking required on all government contracts.

14. Improving the Effectiveness of Incentives Contracting, I. N. Fisher, July 1968, 17 pages.

This is very similar to several of Fisher's works. The theme is the same. Incentive contracts do not achieve their goals of either increased efficiency or reduced costs. Although he recognizes the DOD claim that incentives have achieved improved cost control as evidenced by decreased overruns, he concludes that the apparent cost control is due either to inflated targets or changes. Since many of the targets for weapons systems are in a sole source type environment there is little competition to assure the reasonableness of cost estimates. The keys to improved targets are cost estimating techniques and competition. The advantages that accrue are: improved cost consciousness and improved attitudes toward costs by the government and the contractor. The government assumes the role of a cost conscious buyer rather than a benevolent benefactor.

15. An Evaluation of Incentive Contracting Experience, I. N. Fisher, March 1969, 56 pages.

Fisher studied the effectiveness of incentive contracts as a means for reducing defense procurement costs. He considered the various effects that incentive contracts may have had on both the contractor's performance and contract costs. He compared and analyzed fixed-price contracts (FFP, FPI, FPR) and cost-reimbursable contracts (CPPF, CPIP).

He is not sure whether the underruns observed with incentive contracts resulted from increased efficiency and better cost control, or from larger targets secured by contractors to compensate for the increased risk.

The findings were:

1. Although underruns are more common for FPI than other types, the value of the underruns does not seem to be related to the value of the share rate or the contract size.
2. Therefore it is difficult to attribute the underruns to increased efficiency or reduced costs.
3. The results could be due to inflated target costs, or costly changes.
4. Changes seem to be considerably larger for cost type contracts than FPI type.
5. Some contractors consistently achieve higher underruns than others. Therefore, it cannot be a function of the pricing arrangement.
6. In short, incentive contracts cannot achieve the motivation they are intended for without introducing some means to establish realistic target costs.
7. One obvious way to get better target costs would be to utilize competition more extensively over the entire weapon acquisition process.
8. Do not apply incentives where the technical uncertainties are too great.

9. Incentives still have several advantages: A. They have resulted in better cost information, B. Because the target costs are more realistic, the financial planning is better, C. They might have made the government and industry more cost conscious, and D. Contractors probably have a different attitude toward costs than previously under the CPFF umbrella.

16. Incentive Contracting in the Aerospace Industry, Alvin L. Ferhman, Lt. Col., April 1969, 72 pages.

The profits of the aerospace industry from 1958-1967 are analyzed and then compared to some important aspects of contracts utilized in government procurement.

There are five parts: (1) The introduction, (2) Aerospace industry profits, (3) Government procurement methods with primary emphasis on types of contracts and the role of competition and total package procurement, (4) The CSA--A case history of the total package procurement concept and (5) A discussion of the results.

Ferhman states that the cost reduction efforts initiated in 1961 resulted in a savings of over two billion dollars. He attributes the savings partly from the shift away from CPFF. The DOD decreased the use of CPFF by 75% and increased competitive awards by 30%. In his analysis of profits he concludes that earning ratios for the ten-year period ending in 1967 were consistently equal to or higher than for that of all industry. In review of the TPPC of the CSA he concludes that the method was very successful.

17. An Analysis of the Effectiveness and Utilization of Incentive Contracts with Respect to Their Intended Purpose, Major Julius E. Jones, USAF, and Major Russell Pierre, USA, December 1969, 115 pages.

The intended purpose of this study was to examine the effectiveness of incentives. Jones and Pierre queried fifty contractors and thirty government contracting officers as to their motivations. The results are presented in five sections: 1. Introduction, 2. Intended Purpose, 3. Motivation and profits in industry, 4. Statistical distribution studies, and 5. Conclusions.

The conclusions were:

1. Yes, incentives attain their intended purpose. 2. Profit is the key motivator but other factors play a role. Most of the responses from the research indicated that profit was the major motivation (46% selected profit and 41% firm perpetuatives) in addition to profit, sales maximization and firm perpetuation, as well as socio-economic factors were at times important motivators. He points out that the use of the profit motive in some industries might be incorrect. Industry and government perceptions differed on prime motivation. 3. The distribution of incentive contracts is shaped in favor of underruns. The contention that there is a preponderance of underruns due to overstated target costs cannot be supported. We can also conclude that a significant amount of the underrun can be attributed to the incentive goals being accomplished.

The areas that the author felt deserved further study included:

1. The exact mean of the statistical distribution of incentive under and overruns,
2. The distribution of overruns and underruns by industry,
3. The effect of training on the effectiveness of incentives, and
4. The profit versus the benefits concepts.

Without close administration there is a danger that a CPIF can become a CPFF, and arbitrary ceilings on profits should be reviewed to assure contractors obtain rewards earned.

18. Effectiveness of Contract Incentives, William B. Williams, J. Michael Cummins, Shirley H. Carter, August 1970, 30 pages.

The paper has four parts: (1) the introduction, (2) the model, (3) the empirical analysis, and (4) conclusions and recommendations. Its purpose was to evaluate whether incentive contracts work. Their answer is no. The authors studied several relationships: average overrun, average cost growth, average cost of contract modification, and the effectiveness of share rate, contract size, and type of work in explaining different cost outcomes of incentive contracts. Some specific observations by the authors included:

1. Incentive provisions have little influence on cost overrun,
2. Contractors in some fashion must be shifting the risk to the government,
3. Cost growth and average cost modification varies with contract type. The average cost increases from FPI to CPIF to CPFF.
4. There is an inverse relationship average cost of modification and incentive risk, and
5. The major portion of cost growth is due to contract modification.

The authors recommend:

1. De-emphasize the use of cost incentive provisions and return to CPFF and FFP.
2. Retain the only observable benefit of incentives: better planning, organization and control.

3. If the dropping of incentives is not feasible then retain incentive contracts at a reduced level and include reward penalty provisions relating to contractor initiated modifications.

19. Experiences in Incentive Contracting, Captain William K. Jones, USAF, September 1970, 5 pages.

Captain Jones worked for the Program Office for the Evaluating and Structuring Multiple Incentive Contracts (POESMIC) that was set up in 1968 as part of the Space and Missile System Office in Los Angeles. This office provided assistance in the analysis of multiple incentives to DOD and NASA for contracts over five million dollars. At the time of the writing of this article POESMIC has already evaluated 150 contracts. This article summarizes the major flaws in their design. They were as follows:

1. The cause of most misunderstanding is the concept of the implied value statement.
2. The ranges of incentive effectiveness are not appropriate,
3. The target levels of achievement are inappropriate.
4. The incentive formulas are too complex.
5. The multiple sharing ratios with the range of incentive effectiveness are too complex.
6. Graphical discontinuities . . . i.e., flat spots destroy the trade-off relationships within the range of incentive effectiveness.
7. There are too many parameters.

The article discusses each of these common errors and goes into depth on their implications. Finally he offers the appropriate structures.

20. An Examination of Recent Defense Contract Outcomes in the Incentive Environment, John H. Parker, Capt, USAF, September 1971, 84 pages.

Captain John Parker's advisor was Lt Col David Belden who had previously done an empirical analysis of incentive contracts. Linear regression and variance analysis are used to examine the outcomes of 2,643 Army, Navy and Air Force CPIF, FPI, and CPFF contracts. The basic areas studied were contract growth outcomes, contract profit outcomes, incentive combination outcomes, and extra contractual costs and benefits. Nine questions are raised.

1. What is the relationship between changes and underrun/overrun?
2. What is the relationship of contract growth and the size (shape) of the share ratio?
3. What is the contract growth relationship to contract type?
4. What is the relationship between contract growth and type of work?
5. Is there a difference in average profits by contract type?
6. What is the relationship between average profit and share ratio?
7. Is there a difference in profit by type of work?
8. What is relationship among incentive outcomes?
9. Have there been any extra-contractual benefits resulting from incentives?

Chapter I outlined the problem, Chapter II covered background and theory, Chapter III introduced the methodology and Chapter IV presented the analysis. Chapter V summarized the results.

The conclusions were:

1. No meaningful relationship exists between overrun-underrun and contract change. The theory that contractors may attempt to reduce potential overruns by increasing target costs through changes in the scope of the contract is not supported.

2. Significant differences in average overrun-underrun exist for types of contracts and types of work. CPIF contracts average substantially larger overruns than the FPI and CPFF contracts, R&D contracts average larger overruns than the production contracts.

3. Generally, the contract change percentage of incentive contracts tends to decrease as the contractor's share rate increases. The theory that contractors attempt to recoup losses through change orders and revised specifications is not supported. A negative relationship exists between contract change and contractor share significant at the 1% level.

4. Contracts with large contractor share rates tend to overrun. This conclusion directly conflicts with the incentive theory that the more responsibility a contractor has for cost the more he will be motivated to control costs. This result implies a deficiency in the theory of contract incentive provisions.

5. Contractors tend to earn performance incentives regardless of contract cost outcome. This conclusion implies that contractor motivation may be inclined more toward quality than toward cost.

6. Underruns tend to be associated with early product delivery, and overruns tend to be associated with late product delivery. This result is more an observation than a conclusion. It does imply, however, that cost and schedule incentive are not independent.

7. Going-in profit rates on defense contracts are significantly higher for FPI than for cost-plus contracts.

8. Production contracts average slightly less going-in profit than do R&D contracts.

9. Going-out profit rates are significantly higher for FPI than for cost plus type contracts.

10. Contractor share rates higher than 10% have not generally resulted in higher average coming-out profits.

11. Production contracts with incentives generally average larger coming-out profit rates than R&D contracts, and

12. Cost growth resulting from changes in scope is not significantly related to the initial going-in profit rate.

His recommendations were:

1. Identify and eliminate the causes of improper contract selection and structuring.

2. Make personnel aware that cost, performance and schedule incentives are not independent variables.

3. For further study:

a. Study small defense contracts (less than \$200,000.00).

b. Study the characteristics of the defense industry.

21. An Analysis of DOD and NASA Contractor Profitability in the Incentive Contract Environment, Captain Jerry E. Trimble, USAF, October 1971, 92 pages.

Trimble's basic thrust is to evaluate the effectiveness of incentive contracts. The premises were that the effectiveness would be reflected by the relative profitability of the firms over the time period. Also he explored the extent to which incentive contracts would induce contractors to increase the efficiency and productivity of their capital/labor resources. This study expands on that of David Belden.

The study is broken down into an introduction, methodology, data analysis, conclusions and recommendations. Included is a comparison of the defense industry groups (Fortune 500 and DOD/NASA 100) with a comparable segment of commercial firms. The financial and economic indicators are then compared.

Such factors as return on sales, return on equity capital, and sales dollars per employee are utilized. He divides 65 companies into high, low and medium volume and into six durable goods categories. He concludes:

1. Incentive contracts have not resulted in increased utilization of labor and capital by defense contractors.
2. Profits of incentive contractors do not reflect increased efficiency of incentives.
3. Defense contractors are decreasing their risks through diversification.

22. The Use of Incentives in R&D Contracting: A Critical Evaluation of Theory and Method, Raymond Hunt, Project Director with I. S. Rubin and F. A. Perry, December, 1971.

This study is comprehensive and complex and must be read in its entirety to fully grasp the findings. Any synopsis permits reader perception error that could easily bias the interpretations.

The paper is presented in seven parts within which he severely criticizes the current methods utilized to design and apply motivations to government contracts. Fundamentally he argues that automatic, complex and inflexible FPI and CPIF contracts that assume a single dominant motivational variable (profit) cannot be and are not effective.

The parts of the study are: (1) Introduction and summary of previous findings (his), (2) A recapitulation of previous conclusions (15 specific points are made), (3) Some suggestions for procurement policy from basic psychology where he applies principles from the behavioral sciences to the prevailing assumptions of government policy, (4) The background of incentive contracts, and (5) A critique of incentive contracting.

Of the many recommendations the following are extracted on how to structure R&D buyer-seller relationships:

1. Encourage and facilitate the sharing of information and the clear communication of expectations across all performance interfaces.
2. Establish cooperative attitudes and the cultivation of inter-personal and inter-organizational trust.
3. Provide frequent and meaningful feedback of information to the performer.
4. Make contractual arrangements flexible.
5. Make the contractual arrangements focus on the problems of the procurement and not on the contract itself.
6. The contract should not be such as to discourage active management.
7. The contract should not be structured around some immutable specific universal set of assumptions about either the nature of the performer or the context of the performance.
8. The contract should be structured to leave the tactical problems of intra-organizational subsystems and personal motivation to the managers of the respective organizations.
9. The contract should be mainly rewarded based, be immediate, unambiguously contingent on performance, equitable, and dispensed within a feedback system that makes clear the exact relationship between the rewards and the actions of the performer.
10. The arrangement should be such as to continuously convey expectations of high levels of performance which accurately express the buyers preference. In short, Hunt recommends a managerial instead of a mechanical approach to procurement and R&D project management.

Policy Recommendations:

1. Review procurement and contracting policy
2. Seek greater simplicity and clarity
3. Emphasize active contract management
4. Encourage use of simpler contracts
5. Avoid contracts making specific motivational assumptions
6. Structure contracts to capitalize on motivational assumptions
7. Avoid contracts that assume dissimulation through the contractor organization
8. Generally discourage the use of automatic incentive contracts (FPI and CPIP)
9. Require careful justification for use of incentive contracts and apply incentives only to cost
10. Generally, for R&D, administrative contracts (CPAP and CPFP) should be preferred
11. The CPAP contract should be regarded as a universal alternative to CPFP.

A major thrust of Hunt's (et al) work was to avoid attempting contractually to manipulate motivation in complex organizations.

23. Structuring Defense Industry by Commodity Risk, J. E. Jones, December 1971, 66 pages.

Jones' research builds on the previous studies of risk in incentive contracts. Jones assumed that different levels of risk were associated with various defense industries. If this were true then this risk should be reflected in the incentive contracts. Variations from the expected pattern should reveal areas for improving the effectiveness of incentive contracts and for.

eliminating some of the problems. More importantly, the analysis should reveal areas for saving the defense dollar. In this context, this study looked at the nature of risk in the defense industries and sought to analyze any contract patterns which could be related to industrial risk categories.

He concludes:

1. The traditional approach to incentives according to a review of the literature has several deficiencies.
2. The classification of the defense industry by commodity permits the industry to be classified by risk.
3. Using contract modification as a base, the industry categories can be ranked in terms of risk from low to high.
4. There is a significant difference in overruns and underruns in incentive contracts based on industrial risk categories.
5. The industries in the high risk categories had distribution patterns that underran the targets. The companies in the low risk commodity groups overran.
6. The government should focus on the areas of cost, schedule and performance changes.
7. This approach shows promise in awarding the contractor a separate fee for risk assumptions based on the risk defined.
8. It is recommended that contracting officers consider the risk related to the commodity categories as reflected in the study.
9. Using this data the contracting officer should be able to negotiate more effective fees and thereby should reduce the risk in incentive contracting.

24. A Statistical Analysis of Deviations from Target Cost in Naval Fixed Price Contracts, M. W. Dixon, March 1973, 57 pages.

The objective of this study was to test for a significant relationship between sharing rate and contract outcomes. The parameters considered were: target fee, sharing ratio, ceiling price, target cost, scheduled length of performance, number of articles procured, the number of aircraft and missile contracts initiated, and the year performance started. Another part of the study was to generate a model that would explain the deviation.

The paper has an introduction, description of data, data sources, data analysis, the evaluation of hypothesis and conclusions. Probably the most striking of the conclusions is that no statistical evidence exists that the sharing ratio has any influence on the performance of the contract. Also the negotiated target profit varied negatively with the ceiling price and the target profit varied directly with the number of items procured.

Dixon concludes that since the cost incentive is the cornerstone of incentive contracting it is a little disconcerting to find no empirical evidence to support it. It would seem prudent, lacking supportive evidence, not to place such dependence on incentive contracting to influence efficient contractor performance.

The conclusions were:

1. A statistically significant relationship exists between the negotiated profit rate and the sharing rate.
2. If the sharing rate can be interpreted as a measure of risk assumed by the contractor, these profit rates differentials can be interpreted as risk-premiums that compensate for increased financial risk.
3. A statistically significant relationship exists between the negotiated profit rate and differences in project and contract characteristics.

4. Incentive contracts can have two different effects on contract cost outcomes and contractor performance: the incentive effect and the bias effect. The incentive effect results in more efficient production and tighter cost control. The bias effect results from the tendency of contractors to propose targets that are inflated.

5. No statistically significant relationship exists between the sharing rate and contract cost outcomes.

6. Variations in cost overruns and underruns, costs of supplemental changes, and contract cost growth are unrelated to the value of the sharing arrangement.

7. Values of sharing rates therefore appear to have little effect on contractor efficiency of the costs of weapon systems.

8. Since cost savings advantages appear to be fallacious, the value of incentives must be judged on other grounds than cost.

25. Effectiveness of Incentive Contracts as Motivators, William Foster Hill, Peter Atwood Shepard, Lieutenants, US Navy, September 1973, 64 pages.

Government procurement is an extremely complex discipline involving many detailed areas. In their investigation of this subject the authors concentrated on incentive contracts. The primary objective of this masters thesis was to determine the effectiveness of incentive contracts as motivators for government contractors. A secondary objective was to examine the usefulness of motivational theorists' methods in incentive contracting.

The thesis reports the results of a survey of corporate and DOD personnel. They conclude that the incentives are not delegated within the organization and that there is no observable program of trade-offs to maximize profits. Also in many cases incentives are paid many years following the

actual act thereby negating the motivation. Contractors receive too little attention early in the program. Their conclusions were:

1. Incentives are not passed down by companies to the workers.
2. Motivational programs do not vary greatly from company to company.
3. Administratively all contracts are alike in the eyes of the contractor.
4. The corporate program manager is the first to know of an overrun, and
5. There is not a corporate program to maximize profit through trade-offs even though profit maximization is practiced on the project level.

The authors feel more research is needed in this area. The paper includes quotes from corporate personnel managers that are helpful in assessing industry attitudes and behavior.

26. Incentive Contracts by Money and Methods, Dennis E. Mundhenk, May 1974, 89 pages.

The study's objective was to review the various techniques used for the development of systems. The particular focus is on incentive contracts. Much of the analysis concerns two major systems, the C-5A, and the F-15. The particular concepts included design to costs, prototyping, total package procurement and milestones.

The parts of the paper are (1) Introduction, (2) Incentive contracting by money (contract types), (3) Incentive contracting and the benefits, (4) Total package procurement for the C-5A, (5) The F-15, (6) Design to cost (the A-10), (7) Prototyping, (8) Milestones and other methods, and (9) Conclusions and recommendations. Included in the section on incentives is a chart analyzing

contracts from 1953 to 1973. Also there is a quote of interest by the vice-president of McDonald Douglas that says "incentives are not magic, they are damned hard work. They are hard to structure, hard to manage . . . but incentives are among the best management tools we have." The benefits quoted are better management systems and techniques, better visibility, and better control.

The conclusions and recommendations were:

1. Each major contract should be individually tailored to the particular situation.
2. The C-5A was an example of the plane being fitted to the method instead of the other way around. And then TPP was blamed inappropriately.
3. The F-15 used the appropriate technique. The method was tailored to the needs of the weapon development. The F-15 uses incentives, milestones, prototyping, and parts of the TPP. Several special clauses were used such as the adjust quantities clause that used a predetermined formula to adjust the anticipated purchase quantity up or down by as much as 50%.

27. Cost Growth Effects of Share Ratio and Range of Incentive Effectiveness,
Robert I. Launer, July 1974, 59 pages.

Launer examines several problem areas and relationships related to CPIF contracts. In particular he investigated the relationships between cost growth patterns and (1) the magnitude of the share ratio, (2) the estimable target costs, (3) the difference in the share ratio between underrun and overrun, (4) the range of incentive effectiveness, and (5) the contractors management of control modifications.

1. The "t" coefficient between the negotiated share ratio and the estimated share ratio of the CPIP contracts was .79. Even when the data is restricted to those contracts which experienced an overrun and which had an unbroken negotiated share ratio, the estimated correlation coefficient was less than .25 with a t value of about .75.
2. There appears to be a built-in cost growth base of 20 percent of all CPIP contracts.
3. The data yielded a significant positive correlation between the contractor's share of underrun and contractual adjustments.
4. Contractual adjustments and overruns are statistically independent.
5. The amount of the underrun or overrun which occurs actually is on the average less than anticipated.

This study provides additional insight into the fundamental question as to whether incentive contracts attain the goals for which they were designed.

28. Potential Adverse Effects of Competitive Prototype Validation, James A. Evans, November 1974.

Evans' study was prompted by observations of General A. Miley, Commander of the U. S. Army Material Command about the possible impact that competitive prototype development would have on the effectiveness of incentives. To resolve the question Evans studies several questions:

1. If the validation contracts are CPIP, does the competitive aspect of the situation negate the effect of the cost incentive and hence increase the likelihood of cost growth?
2. Does the competitive aspect increase the likelihood of the contractor goldplating his product?

3. What can be done about the above?

4. Is CPIF the best in this situation? Is there an option?

Evans' results were:

1. The competitive aspects may actually drive the contractor toward cost growth and goldplating. Several programs did achieve their goals. The key was that the contractors in those cases really believed that to win they had to keep the costs down.

2. Each competitive program is unique and the contract type must be tailored to it.

3. Contract type should be a function of the situation. Helpful questions might be:

- a) What is the contractors' motivation?
- b) To what degree does the government want to participate in the development program?
- c) To what extent do you want CSCSC data? FFP precludes it.
- d) Is the contractor sufficiently motivated by follow on business so that he will put some of his own money into the development?
- e) What is the possibility of the contractor shifting costs to other contracts?
- f) To what extent does the contractor believe that the government will place dominant emphasis on cost performance and the accuracy of the design to cost target?
- g) Can the government depend on the contractor to perform the trade-offs?
- h) How much confidence does the government have in the estimate of the development costs?

The ability to answer these questions to a major extent determines the appropriateness of the contract type.

29. Civil Engineering Service Contracts: Relationships of Performance to Contract Types, George C. Shnart, Captain, USAF; Donald W. Kaiser, Captain, USAF, June 1976, 77 pages.

The bulk of the research data was drawn from USAF engineering service contracts and cost accounting records. Questionnaires were mailed to 18 USAF bases; there were 35 observations over a one fiscal year. The data was treated statistically to test the major hypothesis.

The particular interest in this study is the question that it tests: Does the type of contract have any significant relationship to contractor performance? The answer was no. There was none. Also of note, what factors determined performance? It was found to be: (1) In-house contract changes and (2) small business set asides. The author in his section on recommendations for further study raises the question, "Is the increased use of incentive type contracts appropriate for future service contracts?"

30. Understanding Contractor Motivation and Contract Incentives, Phillip E. Oppendahl, Commander USN, May 1977, 45 pages.

Commander Oppendahl compares contractors motivations with incentive contract structures and concludes that they don't match. As a basis for further analysis he provides a hierarchy of needs for defense contractors in various phases of organizational development. He thinks it is perhaps time to develop a new approach to the acquisition of weapons.

His study has six parts: (1) Introduction, (2) Incentive theory, (3) Current incentive contracts, (4) Contractor motivation, (5) Incentives vs. motivation and (6) Summary and conclusions.

The introduction covers the purposes of the study. Of note is that he planned to study only "The apparent contract incentives and not the less apparent incentives such as are contained in the weighted guidelines." Section II reviews incentive theory. He includes primarily policies from the DOD/NASA Guide. Section III examines three 200 million plus contracts; two are CPIF/AF and the other is a cost only FPI. Design to cost, life cycle costs, reliability and maintainability are all considered. The first CPIF/AF portrayed is quite complex and perhaps representative of current practice.

Section IV addresses contractor motivation. The approach is primarily a review of secondary data. Included are Fox, Hunt, Fisher, Hill and Shepard, Cirone, LMI, and Runkle and Schmidt for an analysis of incentives. For general motivational theory he reviews, Maslow, McGregory, Herzberg, Hackman and Likert.

In Section V he compares incentive contract assumptions and contractor motivation. He quotes Hunt, Fisher, Dixon, LMI and Fox that conclude they don't work. He also includes a summary of the LMI review of the Booz-Allen study, Hunt, Jones and Scherer who also are pessimistic of their worth.

From these studies it is apparent that profit is not the prime nor the only contractor motivator. Others include survival, growth, share of market and prestige. Commander Appendahl creatively blends these into a Maslow type hierarchy for companies in varying organizational stages. In stage one the list includes in order: survival, profit, growth, market share and finally prestige. Once survival is attained the emphasis shifts to profits, and then once profits are attained emphasis shifts to growth and so forth.

He provides models of behavior for different stages--i.e., survival etc. Within this context he offers a "shared leadership" model influenced by Hunt's work.

In summary he concludes:

1. The contract industry is a highly interdependent sector.
2. Contract incentives are a major part of today's acquisition process.
3. Little evidence exists to indicate that incentives do in fact motivate contractors to control costs or make trade-offs among cost, schedule and performance.
4. Most contractors are operating on a hierarchy of needs with growth or market share as the dominant force.
5. The government-industry interface is strained by formal regulations and congressional and public opinion.
6. A shared leadership model is offered as an initial step, and
7. Perhaps it is time to develop a new weapons acquisition program.

31. An Analytical View of Advanced Incentivized Overhead, P. J. Lynch, J. Pace, Sept. 1977, 179 pages.

The authors review the history of attempts to implement incentives to overhead and, based on their analysis make a recommendation to implement an approach which they developed. The study's parts are: 1) overview and research method, 2) current activity in the control of overhead, 3) structuring an advance incentive (a model), 4) strengths and weaknesses of the proposed model and 5) conclusions.

If DOD is to control cost growth it needs to control overhead. Indirect costs average 35.9 percent. When subcontractual costs are considered the percentage goes to 54 percent.

Plans attempted by DOD/NASA in the late 1960's, and the APCMD Advanced Overhead Negotiation Test Plan of the early 1970's both met a similar fate of abandonment due to both the government's and the contractor's lack of support. The authors feel a revised approach in the current environment is worth trying.

Specifically four research questions are raised:

1. What are the strengths and weaknesses of current government overhead monitoring systems? The authors give them a high score.

2. How can such a system be structured to stimulate the profit motive? The authors offer such a plan based on incentive concepts, eight steps are offered.

3. What are the strengths and weaknesses of the proposal? Several are offered. Of note among the weaknesses is its reliance on profit alone.

4. Comparing strengths and weaknesses does the proposal make sense? They say yes, primarily since other factors have changed such as ASPR 3-1200 and since the proposal answers many prior objections.

The risks are that contractors could manipulate the system to their benefit if the government administrative team did not perform their tasks adequately.

32. Preventing Biased Estimates in Incentive Contracts, Robert L. Crouch, Professor Economics, University of California, Santa Barbara, California, May 7, 1978, 7 pages.

Professor Crouch argues that incentive contracts haven't worked due to faulty estimates of target costs. His remedy is to engage separate, private sector contractors to provide independent estimates under an incentive penalty

arrangement. His article draws on the works of Cross, Moore, Scherer, Barron and McCall.

He asserts that the 1960's were characterized by unrealistically high target costs. But in the 1970's target costs have been set too low resulting in overruns and low profits. This could have been caused by increased competition or the government personnel "buying in" with the Congress. Both parties have motivation to bias the cost estimate.

The reform procedure would include the following characteristics:

1. The task of target cost estimation should be set apart from the source selection process.
2. Bids for estimating would be solicited competitively under a special incentive arrangement.
3. The target cost estimate made by the successful bidder on the estimating contract would be binding on all bidders.
4. Depending on the penalty rate the estimator's fee would be reduced proportionately based on how much the estimated costs differed from the actual cost.

The author discusses a variety of questions that he hypothetically raises to explore the feasibility of the recommendation. He concludes the process is valid. Cost curves are postulated and calculus is used to develop an analysis of the implications.

33. The Effectiveness of Incentive Contracts: What Research Tells Us,

Richard F. DeMong, Assistant Professor, University of Virginia, May 31, 1978, 8 pages.

DeMong reviews the literature and summarizes the findings on the following:

1. Incentives contracts as motivator
2. Incentives as a means to reduce costs
3. Incentives for better schedules
4. Incentives for better performance
5. Award fee contracts
6. Improving the use of incentives, and
7. Needed research.

At the outset he raises three questions: 1) Are incentive contracts effective? 2) Are these contracts efficient? and 3) Can the government's use of these contracts be enhanced? The findings as summarized by the author are listed below.

Jones and Pierre asked contractors and 30 contracting officers to rank the most important motive for their industry from among profit maximization, firm perpetuation, sales maximization and socio-economic considerations. The industry and government respondents differed in their perceptions. Forty-six percent of the industry respondents selected profit and forty-one percent selected firm perpetuation. The government reversed the order. Forty-three percent selected profit and forty-seven percent selected firm perpetuation.

Hunt in his extracontractual study concludes that R&D contractors were basically risk adverse and that they could best be described as profit satisfiers. He based his study on extensive questionnaires, a review of the literature, and interviews. The need to assume mastery of one's own fate subsumes all other needs. Profit, for example, is a way of accumulating capital resources allowing an organization to make decisions partially independent of its customers.

Hill and Shepard's Naval Post-graduate School thesis questions whether incentive clauses really motivate middle managers. They found no profit

maximization scheme in the seven companies they studied. But this research, like Pierre and Jones, had a small sample. Thus, concludes DeMong, we are left with Hunt who suggests that contractors are amiable to incentives and motivation.

Incentives as a Means to Reduce Costs

Peck and Scherer found that government buyers controlled schedule and quality factors better than they controlled costs. He quotes Gordon Rule that in the past, cost controlling programs were resisted by the government and the contractors. Professor Gorgol of Rutgers concluded that the government was hampered by their lack of knowledge of the contractors' real costs.

John J. McCall of the Rand Corporation pointed out that high cost producers (inefficient) submit lower than expected target costs. McCall theorizes that the problem would become less severe as the line of the incentive share increases. However, when Deavers and McCall tested the hypothesis they found no statistically significant relationship.

Both Fisher and Belden looked at the effectiveness of incentives through empirical research. Fisher pointed out that the only valid way to test effectiveness would be to compare apples to apples. Such is not the case in industry. Belden was not able to conclude that contractors target costs were intentionally inflated. Belden in the same study of 834 contracts found that underruns/overruns were independent of the size of the share ratio and the type of contract. The overrun/underrun was predictable by the type of work. Parker retested these conclusions using a much larger sample (2,683 contracts) and a longer time period. His results varied slightly. R&D contracts had more overruns and changes. However, the overruns tended to increase with the share rate. CPIF's had substantially larger overruns than FPI or CPFF. Again there was difficulty in controlling for the difference in the risk factors of

the type of work. Thus the risk associated with the type of work might be the underlying variable.

Both Belden and Parker found contractors acting in a risk adverse manner. As the risk of the type of contract increased so did the going profit. Also Parker found slightly higher going-in rates for R&D than for production. However, both found higher going-out profits for production; these were higher for FPI and for CPIF or CPFF. Both found that the more closely the schedule was met the lower the cost outcome. According to Hunt the real advantage to cost incentives is that they act as a counterweight to the performance bias of high technology organizations.

Incentives for Better Schedule

Hunt thought schedule incentives were probably superfluous. However, Parker and Belden found a correlation between schedule delays and overruns. Belden found that schedule incentives tend to be lost rather than earned. LMI concluded that if the schedule incentive was designed to convey information from the government to the contractor the incentive was not superfluous. If schedule incentives are not included the contractor might make an undesirable trade-off for performance of cost.

Incentives for Better Performance

Hunt thought that performance incentives were probably redundant. Belden and Parker came to the same conclusions. They were earned whether there was an underrun or overrun. In a study of civil engineering contracts, Ehner and Kaiser found no statistically significant relationship between contract type and performance. However, not including them might send an undesirable message to the contractor.

Award Fee

Less than 2% of all contracts in dollars was on award fee in 1977. Perhaps that coupled with the fact that it is a relatively new contract accounts for the few research studies. Douglas Egan said that the major incentive in the award fee system may arise from the formal record of evaluated performance rather than the immediate fee earned. Hunt thought that award fee contracts are simpler structurally but more demanding to administer. He also thought that they came closer to the principle that the fee should be earned rather than awarded in advance. The award fee does not depend on the primacy of the profit motive. It can best be looked at as a managerial method rather than a contract type. Mel Byers of the USAF in a study of 13 contracts found that as the contract progressed the fees increased . . . an indication of the learning curve effect. In a similar study of 56 contracts Jack Runkle and Gerald D. Schmidt of the Air Force found that the effectiveness of the award fee increased with the level of the evaluation and the frequency of the interaction between the parties. Byers found no relationship between the level of the fee and performance. Shirley H. Carter found that the size of contract, magnitude of the absolute maximum fee and the relative size of the potential award fee were not related to performance. However, the level of fees has a negative relationship to the relative size of the fixed fee. Thus we have some guidance on how to structure and administer award fees to make them effective motivators. But are they efficient? Do the benefits outweigh the costs? DeMong concludes we may never know.

DeMong concluded with some questions for additional research. These were (1) How do we provide incentives that compliment the contractors desire to avoid risk? (2) How can we apply incentives selectively to types of work? And (3) What is the impact on small firms?

34. An Empirical Study of USAF, FPI, and CPIF Contracts. Final Report of Contract F33615-76-C-5371, Kenneth M. Gaver and Jerold L. Zimmerman, University of Rochester, 30 pages.

Gaver and Zimmerman analyzed the data base from four computer tapes received from the Air Force. The tapes contained information on three USAF contract forms: DD350's, DD1499's, and DD1500's. The data was reviewed to eliminate inappropriate data and to isolate Air Force contracts. The dates of the contract data ranged from 1969 to 1974. The final batch contained 639 contracts that had at least one DD350, one DD1499 and one DD1500. There were 135 FPI and 57 CPIF contracts. The study is divided into three parts: 1) The nature of the data base, 2) A summary of tables and graphs of the data found in the data base, and 3) A presentation of several behavioral propositions that can be tested from the data base. Some of the findings are as follow:

1. There was a slight tendency toward cost underruns for both FPI and CPIF contracts.
2. The various incentives (values, schedule, etc.) do not have a large impact on costs.
3. The initial profit on FPI (10%) is larger than on CPIF (8%).
4. After eliminating contracts with target cost differences, FPI contracts no longer reported underruns, but rather a slight overrun, whereas CPIF had a slightly larger underrun than previously.

The authors conclude with eleven propositions that they feel can be tested from the data base in future research:

1. The profit rate is inversely related to the size of the contract.
2. On contracts with broken share lines the profit rate varies inversely with the share rate.

1. The higher the share rate the less likely that a cost overrun will occur.
4. The magnitude of the overrun/underrun varies inversely with the share rate.
5. The proportion of contracts ending in cost overruns is the same for contracts with both broken and unbroken share lines.
6. The frequency of adjustment of the share line is inversely related to the share rate.
7. The higher the profit rate the more likely an overrun will occur.
8. Profit rates on CPIF contracts are on the average higher than on FPI contracts.
9. The probability of an overrun on an FPI is independent of the ratio of TP/TC.
10. The probability of a cost overrun occurring on CPIF contracts is independent of the ratio of the maximum profit fee to target profit.
11. The probability of a cost overrun occurring varies with the length of time required to perform the contract.

VII. Award Fee Contracts--Effectiveness

Award fee contracts evolved shortly after the impetus of the use of incentives in the late fifties. They apparently were used first in the Navy and subsequently by the other services (particularly NASA). Initially they were intended for use where the traditional contracts were not applicable (see NASA Guide of 1967) but have in the seventies been applied, usually in combination with other traditional incentives to weapon systems as well as the service area. The major studies of Hunt for NASA supported the feasibility of the award fee. Professor Hunt has strongly recommended its use instead of the CPPF or the traditional incentives. Part of the reasoning for the use of the award fee is that the profit motive alone is insufficient as a motivator to influence contractor behavior. Naturally these studies on CPAP are a rich source for observations and opinions on the factors that indeed do presumably motivate the contractor.

This part of the bibliography separates the award fee to provide the researcher the opportunity to readily have access to the ideas and findings associated with a contract type that purports to be based on a multiple motivational basis as compared to the short-run profit maximization assumed for the CPIP and FPI contracts.

1. A Study of the Relationship Between Contractor Performance and the Magnitude of the Award Fee in the Cost Plus Award Fee Contract. Mel D. Byers, March 1973.

The study analyzes contract data from the Houston and Goddard Space Centers. Its initial objective was to see if the relative dollar value of the award fee could be used to help assure better contract performance. The author reasons that the government could examine fee levels in a number of

completed contracts in a specific area (e.g., medical services) and provide guidance for similar contracts. Reductions or increases in award fee could then be made as applicable. This presumed that a significant direct relationship existed between the dollars "offered" by the government under the award fee provision and percent of dollars "earned" by the contractor.

Another specific objective was to present and analyze the major factors that influenced contractor performance. The intent was to demonstrate that many factors, other than just dollars, have an effect on contractor motivation. The overall objective was to provide a better information base for procurement personnel to use when negotiating, administering, and monitoring CPAF contracts.

Several conclusions were offered:

1. No relationship exists between the relative amount of award fee offered by the government and the level of contractor performance.
2. CPAF contracting is a viable form of incentive contracting with numerous advantages over other incentive types.
3. Performance evaluation techniques vary extensively.
4. Extensive cross-sectional CPAF studies have not been made.
5. Extra-contractual influences play a major role in contracting.

The major recommendations were to:

1. Conduct broad "across the board" (DOD, NASA) studies of the CPAF control,
2. The Air Force should conduct its own study, and
3. The pure CPAF rather than CPIF/AF should be tried for both hardware development and support services.

2. Reward Fee Provisions in Defense Contracting. John T. Buck, Colonel, USAF, March 1974, 74 pages.

Buck studied whether incentive contracts can motivate good management decisions in defense related procurements. It contains a description of cost-plus-award fee and the traditional incentive-fee contracts. The study uses the F-15 weapon system as an example.

He concludes that the award of a fee for excellent accomplishment can provide favorable motivation for contractors where day-to-day performance is difficult to measure objectively. The F-15 contractor had earned close to 90% of the available incentive fee because of its excellent performance. Buck concluded that the incentive or award fee technique provides an excellent stimulus for improving results in defense procurement.

3. An Analysis of Government/Contractor Interaction as a Motivator of Contractor Performance. Jack R. Runkle, Captain, USAF; Gerald D. Schmidt, Captain, USAF, August 1975, 102 pages.

Runkle and Schmidt collected data from five NASA centers; it included 323 "Performance Ratings" on 56 contracts over a period of 8 years. In the study Captains Runkle and Schmidt examined the factors that influence the effectiveness of the award fee contract. Two hypotheses were tested: (1) That a relationship exists between contractor performance and the level of authority within the organization that is responsible for performance and (2) That a relationship exists between contractor performance and the frequency with which the influential positions formally interact in the contractor performance evaluation process. Both hypotheses were supported. Runkle and Schmidt conclude that the key to motivation of contractors is to communicate the performance of government performance objectives and to assure interaction in

their accomplishment. Interaction of the top level management personnel with the government personnel is the key. In their discussion of motivation they point out that the motivation for small and large businesses might vary. Large contractors are risk adverse in general. Also, the size of the organization and the magnitude of the program determine risk acceptance or risk aversion.

Also of general interest is the section on contractor extra-contractual motivators. Included are maximization of joint profits, maximization of growth and maximization of sales.

4. An Inquiry into the Use of an Award Fee for Motivation of Subcontract

Management. Charles D. Evans, Major, USAF, May 1976, 43 pages.

Evans examined the existing literature and the Air Force Systems Command's "Summary of Management Surveys and Contractor Procurement Systems Reviews." He studied 12 prime associate contracts and 46 subcontractors and analyzed 6 years of Congressional material. He also conducted interviews with a limited number of AFSC managers.

His recommendation is to use award fee contracts with subcontractors. Along the way the author covers (1) Subcontract Management, (2) Incentive contracts, (3) Award fee contracting and (4) Conclusions and Recommendations. Of interest in addition to the inquiry of the applicability of award fee to the subcontract area is the analysis of the incentive contract concepts presented in the second part. It includes the nature of incentives, the types of incentive contracts, the use of FPI and CPIF contracts, the nature of motivation and a summary of the incentive contracting studies as of that date.

5. The Award Fee Incentive: Management Considerations Regarding its Application to Research and Development Contracts. Jerry V. Brown, Major, USAF, November 1976, 31 pages.

This paper provides a good summary and review of the advantages and disadvantages of the award fee contract. The paper reviews (1) The history, (2) The rationale for the award fee, (3) Influences of the contractor and (4) Management considerations, summary and conclusions.

A particularly valuable part of this paper is the summary on extra-contractual influences. The study relies heavily on the works of Dr. Raymond Hunt. See bibliography.

6. Award Fee Contracting: Impact of Incongruent Goal Incentives. Lee R. Knopf, Major, USAF, November 1977, 52 pages.

Major Knopf's paper consists of (1) An introduction, where he develops his theme of concern about the practical problems of award fee contracts, (2) A section on the "real world" problems of award fee incentive contracts, (3) A section on the problem of conflict between goals and values and (4) A section of conclusions and recommendations. He states that the award fee alone is not the real motivator. He, contrary to the research of J. Runkel et al., also finds that top level organizational contact adds little if anything except a more costly administrative system. Finally he concludes that the award fee does provide some flexibility if the values and goals of the procuring organization are not force fed into the contractor. He has five recommendations and/or observations.

1. Further study of this topic should be made and a statistical means developed to determine if award fee criteria are consistent with the contractor's long and short range goals.

2. More information is needed to determine the impact of short evaluation periods and changes in emphasis.
3. Fee determining officials should be located at a level most conducive to the role of an integrator where maximum contact with the operating level personnel is permitted.
4. There should be developed a survey questionnaire to allow a contractor to report areas for improvement consistent with the company's goals, and
5. Guidance should be developed to alert procurement and program managers to the potential conflict caused by inconsistent goals between organizations.

VIII. Contractor Motivation--Extra Contractual and Contractual

Many of these could have been catalogued with the incentive effectiveness studies. I have included them separately to highlight the question of contractor motivation. It is at the heart of the "do incentives work" debate. What really motivates the contractor? The early incentive guides assumed for purposes of establishing policy that the profit motive was the underlying and principle motive of business. This hypothesis has long been questioned in the literature of organization and it was not long before various researchers began to take the proponents of this theory to task. The purpose of this section is to reflect as accurately as possible the nature of the dispute and the positions taken. The papers provide a representative list of the extracontractual factors and their influence on incentive contractual outcomes. For additional papers on motivational factors see the sections on incentive effectiveness on manuals and on award fee. For an early outline of the extracontractual factors see the 1968 DOD/NASA contracting guide and the '66 LMI study. The most comprehensive in-depth study appears to be the four-year NASA funded study to the University of Buffalo under the auspices of Bliss and Hunt. Hunt has published several papers on contractor motivation stemming from this and subsequent work.

1. Weighted Guidelines. Letter from Col. William Thybony, Chairman of the ASPR Committee to the U.S. Chamber of Commerce, July 17, 1963.

Of particular note in addition to general historical interest are the fee levels commented on in this letter. The purpose of weighted guidelines was to replace the existing industry fee traditions with an analytical approach to the determination of a fair and reasonable profit. This document by spelling out what might be considered appropriate ranges for the different types of

contracts had a significant impact on the subsequent setting of fee levels.

The ranges and the types of contracts were:

1. CPPP . . . 1%
2. CPIP . . . Cost only 1 . . . 2%
3. CPIP . . . Multiple . . . 1 to 1 2/3%
4. FPI2 to 4%
5. FPR4 to 5%
6. FFP5 to 7%

Note that this is not the total fee but that portion to be earned by the willingness to assume the risk inherent in the contract type.

2. Blending Motivational Theory and Formal Contractual Disciplines. James E. Cravens, Special Assistant to the Director of Procurement, NASA, October 3, 1967, 19 pages.

This is one of several incentive papers that Mr. Cravens presented in 1966. Others included those at the Universities of Hofstra, Purdue, Notre Dame and Buffalo. All the talks are similar and address the subject of the developing science of incentive contracts. In all of them he talked about the lessons learned and the research being sponsored to address the issues uncovered. Of particular concern to him was the motivational extra contractual factors. The burning questions being raised by a number of studies (including RAND, IDA, LMI) centered on whether incentives were working. And the answer often was either we do not know for sure or that there are other factors than profit that motivates contractors. This was his focus. He also reviewed the research being supported by NASA at Ohio State, George Washington and Buffalo to find out the answer to contractor motivation. Cravens was critical of the studies that had been made that condemned incentives saying that the studies

were based on too narrow a source of information without broad informed conclusive analysis. He concluded his paper on a discussion of the encouraging experiences of the CPAP contract and NASA's intent to pursue that contract type more intensely.

3. Management of Major Weapon Systems Acquisition. Honorable Barry J. Shillito, January 1970, 4 pages.

This rather short article summarizes the weapon acquisition process and comments on some thoughts for improvement. Of particular interest to incentive contracts are the identification of the risks and the general observations of the management changes made in the sixties.

The risks cited are: 1) The time it takes to develop and acquire a weapon system, 2) The many fields of technology that a weapon system includes, 3) The ever-changing emphasis of our adversaries, 4) The unknown unknowns and 5) The risks peculiar to the weapon system itself.

In terms of the management changes made in the late fifties and sixties, Shillito feels that they are in the right direction but that they "may have moved so far that we have deprived ourselves of appropriate flexibility to allow the most effective acquisition to take place." He concludes that it is impossible to find one single policy or method of management which fits all.

4. Motivating Contractors--Is Incentive Contracting the Only Answer. Donald C. Barker, November 1974, 43 pages.

Barker discusses the concept of incentives and then discusses their use as motivators. He also discusses factors that may be more important to a contractor than profit.

He concludes that each contractor must be judged separately to determine what actually motivates him. Different contractors have different motives. What motivates one may not motivate another. Since the profit motive is the essence of incentive contracting, it cannot be universally effective. The content of this paper can be gleaned from a quote from the study:

"During the past several years, it has been widely accepted that the profit motive is not the number one motive for the majority of individuals in our society because most of them are far enough up Maslow's ladder of needs that they have passed those things that money can get for them. I think that, as with individuals, the profit motive is not the basic motive of business. We must strive to evaluate the motives of contractors on an individual basis before we attempt to furnish incentives to motivate the contractor to a particularly desired outcome. Until this concept is accepted and until intensive work is done to evaluate contractor motive on an individual basis, we can never be sure, no matter how much of the taxpayer's money is put into the incentive fee pool, that we are using the most effective and productive means to motivate the defense contractor."

5. Investment Policy for Cost Reduction. Harold E. Bertrand, Henry J.

Boisseau, Jean C. LaFrance, Anthony J. Provenzano, December 1976.

From 1967 to 1976 the annual expenditure for military goods remained almost constant. But because of inflation the real purchasing power dropped 53%. In recognition of the fewer dollars DOD instituted several programs to stimulate investment in facilities to increase productivity. Included were:

1. A revision of weighed guidelines to tie part of the negotiated fee directly to invested capital.
2. The initiation of a DOD investment policy study in '76.

The report has three parts:

1. An analysis of investment policy (Opportunities, Motivating factors, DOD policy, Additions to policy needed, and Summary).
2. Investment Case Studies (F-4, F-15, F-16 with Bell Helicopter).
3. Appendixes (Macro economic analysis, Present value, Sources of capital and Investment and references)

The study suggests that contractors now invest to either (a) gain contracts or (b) fulfill contractual obligations. The recommendations were to provide for:

1. Shared savings--i.e., Value Engineering
2. Rapid depreciation
3. The use of more multiple year procurements
4. Broader protection from termination and
5. Economic price adjustment indices.

6. Understanding Contractor Motivation and Contract Incentives. Phillip E. Oppedahl, Commander, USN, May 1977, 73 pages.

Oppedahl's purpose was to study contractor motivation. Toward this end he studied DOD policy on the use of incentive contracts, reviewed active contracts and interviewed contract officers, and studied literature concerning the motives or drives of defense contractors.

There are six parts to the paper: 1) Introduction, 2) Incentive theory, 3) Current incentive contracts (reviews two CPIF and one FPI), 4) Contractor motivation, 5) Incentives vs. motivation and 6) Conclusions. In the study the author reviews the theory of incentives, studies three existing contracts, reviews the literature on contractor-incentive motivations and then reports on

his observations as to the verification of the theory as demonstrated in the contracts studied.

Oppedahl concludes that incentives cannot be effective since profit is not the sole motivator. "It was found that just as an individual, a corporation has a complex and time-dependent motive structure. In addition to profit, the management of defense industries are concerned with company survival, sales growth, technical capability growth, market share, prestige and public opinion." He found "little evidence which indicates that contract incentives do in fact motivate contractors to control costs or make trade-offs between cost, schedule and performance. Contractors are performance oriented and will not, in general, trade-off costs at the expense of performance especially when increased costs are associated with company growth."

He proposes a time oriented motivational model based on survival, profit, growth, market share, and prestige in a Maslow context. These are in ascending order. Over time the dominant motivational variable changes. It is a most interesting model and one that may lead to a more complete understanding of the complex motivations of contractors.

Finally, Oppedahl recommends an industry-government shared leadership model to replace the currently strained formalities of the current government-industry complex brought about through the myraid of regulations, public opinion and congressional pressures.

7. Federal Procurement: A Study of Some Pertinent Properties, Policies and Practices of a Group of Business Organizations. Raymond G. Hunt, Ira S. Rubin and Franklin Perry, Fall 1977, 53 pages.

This is the final report of the work done by Dr. Hunt for NASA under Grant NGR 33-0153-061. This study analyzed twenty-seven companies through a

questionnaire to a) find reactions to government policies and procedures, b) describe general business objectives and managerial methods and c) see how the firms viewed the future business prospects of their firms. Forty-one dependent variables were systematically cross-tabulated against eight independent variables. Of interest are the independent variables. These are 1) prime or subcontractor, 2) sales volume of parent company, 3) sales volume of responding company, 4) the government/commercial mix of parent, 5) the government/commercial mix of responding company, 6) the volume of R&D investment, 7) the number of prime contracts held and 8) the dollar value of the prime contracts held. The general conclusions included:

1. Sales stood out as a dominant independent variable.
2. The parent company's sales are linked to R&D investment.
3. The prime contractors tend to have a lower ratio of commercial to government business.
4. For most of the companies no special administrative techniques were employed for the incentive contracts. Fully two-thirds made no adjustment to achieve maximum gain.
5. There was little or no awareness of incentives presumed below first line supervision. It was unusual to strive to extend awareness to the operating level.
6. Contractors increased their attention to incentives as the number and the percentage of their incentive contracts increased.
7. Incentives do not generally affect resource allocation.
8. Many of the firms were disposed toward reducing their percentage of government business.

In addition Dr. Hunt suggested certain contracting goals. These were in order of importance:

1. To foster quality performance
2. To protect against risk
3. To safeguard proprietary nature
4. To stimulate high level of government communication
5. To engineer high motivation to control costs
6. To yield a high profit level
7. To reduce government direction or surveillance
8. To foster program discipline

Also in terms of the function of profits he suggested that goals were:

1. To enlarge capital growth
2. To pay stockholders and attract capital
3. To meet current capital requirements
4. To finance internal R&D
5. To demonstrate suitability of overall performance

This is a difficult paper to summarize accurately. These statements to be appreciated and comprehended must be reviewed within the full context of the study.

8. Factors That Influence Organizational Performance (A paper presented at the Hershey, PA Research Symposium). Raymond G. Hunt, Janet P. Near, Ira S. Rubin, 1978, 4 pages.

The perceptions or beliefs of managers about what determines organizational performance, the interrelationships of measures of belief with other measures of motivation and the managers views about what makes for effective R&D performance are the focuses of this study. It was part of a larger NASA funded study.

The paper is short and primarily addresses itself to the methodology of the inquiry. It is divided into: the study, the measures of performance, motivation and performance and effective performance. The authors conclude that in motivation and performance, perceptions are not simply an expression of the perceivers viewpoint; instead they reflect the literal everyday life of the organization. And these indicate that organizational life is rather disjointed: goals of the organization and its subsystems, as well as perceptions of environmental constraints, appear to be only weakly related to conceptions about what factors influence project performance. The picture presented is that the goals of the organization are arrived at randomly and that the process generally is haphazard and seemingly not integrated.

As regards effective performance the respondents emphasized such things as clear work statements and availability of resources, and they de-emphasized modes of project management, contractor-customer relations and the contract per se. The one most mentioned was having capable technical personnel.

The study concludes on the note that "it is time to develop more systematically the basic theory of how perceptions of members of organizations relate to the behavioral reality of organizational structures." We need to know more about how organizations really function.

9. A Uniform Profit Policy for Government Acquisition. Robert K. Wood and Myron G. Meyers, Logistics Management Institute (LMI), May 1979.

Wood and Meyers summarize the earlier LMI study on the proposed profit policy that emanated from recommendations of the '72 Commission on Government Procurement. The paper covers the scope of the LMI effort and presents the findings. Of particular interest are the factors related to profit. These are: the selection of contractor, the selection of contract type, the

selection, and application of contractual incentives, the inducements for investments, the cost estimation and negotiation, the contract finance policy, the contract administration and the use of government property. Two profit approaches are considered. One is cost based and the other is tied to the capital employed. The paper alleges that cost based firms are less efficient since they are not motivated to increase the inputs of capital equipment. Cost based structures are recommended where the use of capital equipment is a minor influence on the total cost of performance. A hybrid system that combines both a cost and a capital employed approach is recommended where capital has significant benefit to the government. Adjustments should be made to reflect a) the risk associated with contract type and b) the entrepreneurial skill required on complex tasks. It is suggested that adjustments be made after applying the profit formula as a percentage of the estimated costs of performance. Finally, a procedure to encourage cost savings investment through the sharing of resulting cost savings is included. Overall target rates are necessary for both approaches as are risk and complexity adjustment rates. The principal is to allow the contractor to earn a commercial equivalent rate of return for work that has similar capital requirements, risk and complexity. The long term target rate for manufacturing before interest and taxes is 16.6% on total capital employed. The article has an interesting table that summarizes the proposed profit policy. Within the matrix it is suggested that + 1.5% be available for contract risk. Totals for manufacturing are 8.5 to 12.5% of cost and 14.1 to 20.7% on capital.

This recommended LMI policy has a variety of implications on the incentive contract philosophy.

IX. Mathematical Models--Incentive Contracts Evaluation and Development

The common thread through these sometimes esoteric papers is the use of some form of mathematical or related approach to either 1) evaluate the existing methodologies or 2) to propose new ones. In some cases the articles do both. Another common element is that most of these enclosures are from articles rather than empirical studies. The techniques include game theory, isof a or indifference theory, expected value, calculus and optimization, sensitivity analysis, life cycle costs, statistical probability theory with Gaussian, Beta and exponential functions, decision theory under uncertainty and risk, simulation and computers and nomography. The models and related analysis in many of the instances were not undertaken to provide a working day-to-day model. Rather the intent often was to provide some insight to the variables in the problem, their relationships and the impact of changes in their values. As such there are some very provocative articles. See for example the articles by David P. Barron on Competitive Bidding and Quantification of Contractor Risk by Clifford W. Marshall.

Many of these articles could easily have been placed in section 7 or 8. See particularly, Major Pirdle's paper. See also that of Captain Moore and Professor John M. Cozzolino on more effective cost incentive contracts through risk reduction.

On another note, those interested in the question of risk determination, measurement and evaluation will find these papers a rewarding source for their efforts.

1. Operations Research's Contribution to Structuring and Negotiation of Aerospace Research and Development Contracts. John J. Kennedy, Ph.D.,
University of Notre Dame, September 1963, 11 pages.

The paper is in three parts: A discussion of several techniques and their possible use in analysis, the application of probability theory to structure and design of incentives, and implications. There were seven conclusions:

- A. The most probable cost will be about the target.
- B. The most probable outcomes should be around target.
- C. The share line is not consistent with the probable outcomes.
- D. The extremes around the outer ranges of the RIE are very unlikely and consequently of little motivational value.
- E. The idea of incentive range and the probable cost swing needs to be modified.
- F. The adding of incentive elements reduces substantially the probability of reaching maximum profit.
- G. Steeper share lines might be appropriate around target even for wide ranges of cost variation.

It concludes that the arbitrary use of cost swings and the straight share patterns are inconsistent with probable outcomes and that they lose much of their ability to motivate.

2. Project Management: An Incentive Contracting Decision Model. W. A. Meinhart and Leon M. Delionback, Oklahoma State University, Dec. 1963, 7 pages.

The authors employ zero-sum 2 person games to model the decisions made by the project management of a complex research and development item on an

incentive contract. The authors' intent was to gain additional insight into the process; it was not the intent to develop an operational model. They use the conventional two person matrix and assume that short run phenomenon follow a beta distribution and that the long run follow the normal distribution. Minimax theory, matrix iteration, or linear programming can be utilized for solution of the problem suggest the authors. Probabilities are established for each of the incentive parameters. Data is computed for the most pessimistic, most likely and most optimistic forecasts of the parameters. The payoff is calculated by multiplying the probability by the contractual maximum. In this fashion the probable payoffs (incentive targets) are estimated.

The paper has three parts: 1) The project management background, which includes a very brief outline of the acquisition process, 2) The incentive contracting model which presents the concepts of game theory and gives an example and 3) A summary which provides a schematic of the process suggested.

3. System Worth and Incentive Contracts. W. C. Frederick, ARINC Research Corp., Washington, D. C., January 24, 1964, 9 pages.

Frederic concluded that incentive contracts were not effective since they did not tie system worth to the incentive parameters. The paper is devoted primarily to the development and description of a system to provide such relationships. It is divided into: Summary, Introduction, Review of contract types, Incentive types, Deficiencies of present incentives, Relating worth to incentive fees, Summary and Conclusion. The deficiencies cited were:

1. The fee is tied to only one or a few areas.
2. The relationship between fees and the degree of excellence of the performance areas is not determined optimally.

3. There is often no serious efforts made before the award of a contract to determine the degree of performance accomplishment (that) could be expected.
4. Government agencies often award contracts before the requirements are known.
5. The government constrains inventiveness and ingenuity by the lack of flexibility in the structuring of the incentives.
6. As used thus far incentives have achieved less than the desired results. This can be improved through the use of the system worth approach described herein.

4. Risk Inversion and Incentive Contracts, An Experiment. G. J. Peeney, W. H. McLaughlin and R. J. Woolson, August 1964.

A simulated negotiation conducted with undergraduate students was the basis for this paper. In the negotiation the students were told that they were competing against two other students (in fact against the computer data bank). They varied the share line between 10 and 50% to view the reactions of the "Firm." The hypothesis was that the firm would attempt to increase the profit as the shareline increased. This was confirmed. The results showed that both the aversion risk and the expected profit varied with the share. These results refute almost all the literature on the relationship between share and profit. Most of the findings suggest contractor behavior is not related to share. Probably the results are such because the students did not have the options that companies have.

5. A Model for Marketing and Pricing Under Competitive Bidding. Kenneth Simmonds, Assistant Professor, Graduate School of Business, Indiana University, 64 pages.

Simmonds outlines some features of a decision model for competitive bidding for large contracts. It integrates production capacity, outstanding orders, volume and profitability of future and present opportunities, variable bid features, advantages of carry on future work, and costs of capacity. The model is adapted from a broader study of decision-making capital goods firms.

The paper is divided into the following parts:

1. The decision to bid . . . the pre-acceptance costs,
2. Expected contribution . . . the net cash flow times the probability of getting it and the present value of follow-on advantages,
3. The expected probability of success . . . the probability of an order times the conditional probability of success,
4. The availability of capacity,
5. The capacity and the bidding limit . . . the expected volume of bids and firm orders that will minimize the firms expected loss from not exactly achieving capacity,
6. Comparing alternative opportunities,
7. The selection of bids and markups and,
8. The final pricing decisions.

This models suggests the variables that should be considered in any analysis of incentive contracting.

6. Pricing Policies Contingent on Observed Product Quality. Eugene P. Durbin. May 1965.

Durbin notes that the expanded use of incentive contracts has created interest in a possible procurement arrangement in which unit purchase price would vary as a function of the observed product quality. Under the assumption that a known cost producer can control the true quality of his output, a production and procurement situation is described in which a producer and consumer both attempt to maximize expected profit; the consumer by selecting a pricing strategy and sample size, and the producer by then selecting the product quality.

A method for deriving continual linear price schedules is briefly described and extensions of the basic approach are noted.

7. Stoics Systemic Techniques of Incentive Contracting. W. Hagen, For George Marshall Space Flight Center, Huntsville, Alabama, September 1966, 128 pages.

Mr. Hagen was on the executive staff of Dr. Werner Von Braun, and as Dr. Von Braun was not completely satisfied with the traditional approach to incentive as defined in the NASA Guide, he asked Mr. Hagen to devise an alternate. The systematic technique of incentive contracts was the result. The manual provides a series of slides and tables which demonstrate the construction of three contracts for Widgets. His premises were that the contract should assure:

1. That target objectives should be met or bettered at a bargain price,
2. Target objectives should be met even at an additional cost and
3. The contractor should be penalized for additional costs.

Mr. Hagen postulated that the government-industry relationship was a bilateral monopoly for the life of the program. The purpose of the incentive was to substitute for the functioning of the normal market. The unique aspects include the application of nomographs to the design and analysis of

the trade off options and the subsequent management of the contracts. Probability distributions are imposed on the vertical axis of the nomograph to estimate the changing probabilities as new information is gained with the passage of time.

8. Multiple Incentive Contract Analyzer (Three Volumes). The Boeing Company, December 1966.

The development of complex incentive features in multiple incentive contracts necessitated the development of a variety of mathematically based models for their design and analysis. PIIM was an example of such a model. The purpose of MICA (Multiple Incentive Contract Analyzer) was to provide a computer tool to aid in such evaluations. MICA provides a computer program that allows for such evaluations at anytime during the contractual process. This document, comprising three volumes, describes the MICA II computer model operation, input requirements, and programming.

Vol. I Descriptive in its treatment of the model and its use.

(Management tool)

Vol. II Technical description of the model. (Users tool)

Vol. III Is entirely computer oriented. (For the programmer)

The model uses a series of probability distributions to produce contractor's fees. The model also applies a probability distribution to each of the incentive elements.

9. The Evaluation and the Structuring Techniques of Multiple Incentive Contracts. Dept. of the Air Force--Faculty Group, USAF Academy, Colorado Springs, Major Jack W. Cook, Capt. Don E. Ackerman, Capt. Maurice V. Clegg, Capt. John D. Johnson, Capt. Robert U. Kurtz, Aug. 1966, 241 pages.

The manual describes techniques for the structuring and analysis of multiple incentive contracts. It was the combined effort of the Air Academy staff and the pricing office of the Space Systems Division, Los Angeles. A variety of briefings were given to DOD and NASA on the contents of the manual. The manual is accompanied by two color training films.

The contents are: 1) An introduction, 2) An evaluation of incentive contracts, 3) Structuring the incentive contracts, and 4) General conclusions. There are some 71 illustrations. The models are constructed based on isofee lines analogous to isoquant curves in price theory or indifference curves from economic theory. Cost, for example, is plotted on the X axis and performance is plotted on the Y axis. There are an infinite (usually) number of curves that will produce the same fee for the contractor. The curves are produced by the computer through iterations to establish acceptable sets of parameters.

Chapter Two develops the trade-off analysis technique and the curve fitting technique. Techniques are also introduced to develop or check the various performance parameter combinations to assure that the relative values are consistent with the goals of the government. Cases and examples are provided. The computer data is in the appendix.

10. A Systems Approach to Incentive Contracting. D. Harold Asher, Deputy Assistant for Defense, October 17, 1966, 18 pages.

Asher concludes that the current approach to incentives, and particularly performance incentives does not relate the incentive parameters to total system cost and system effectiveness. The paper includes: a) An introduction, b) A brief description of the proposed new approach, c) A procedure for implementation, d) An evaluation of proposed changes, e) The problems of implementation, and f) A summary. Eight pages of charts are attached.

The author states that even under the most favorable conditions DOD has no assurance that it is obtaining the preferred set of physical and performance characteristics. For a given level of system effectiveness it would be quite rare to find the same set of parameters that maximizes the contractors profit or minimizes his losses as well as minimizes the long range cost to the government. If it is necessary a contractor will enhance the performance elements to offset potential loss. In general, contractors are encouraged to add to their profit by enhancing performance and thereby increasing the total cost.

And profit is not the only motive. Others include company pride, maintenance of high levels of business activity and employment in the long run. But since Asher feels that he cannot deal with the extra contractual factors he assumes that the financial motives are dominant for purposes of the paper.

He notes that the possible solution to the problem is to tie performance parameters to total system effectiveness and costs. In this paper Asher goes through an example of the development of the parameters of a new aircraft system through curves relating total cost and the selected parameters and derives the minimum cost point on the graphs. Incentive fee points are derived for a series of levels of effectiveness and a curve is drawn utilizing the points derived.

The problems he notes in implementing the system are many: these include changes, the selections of variables and the assumption of a static system.

Dr. Asher suggests other sources for studies on total cost approaches to incentives: the Air Force Academy work, the studies by Management Systems and by LMI. He concludes by noting that cost and system effectiveness techniques were being used in the Navy light attack aircraft and in the Air Force C-5A.

11. Expectations of Contract Incentives. John Finch, Standard Oil Co., Indiana, 1966.

Finch suggests that the application of statistical risk assessment is applicable to incentive contracts. The paper uses the C-5A as an example to demonstrate the use of expected value of fees during the formulation of structure. He discusses the advantages of expressing incentives in terms of systems cost effectiveness and illustrates the use of the techniques in the development of customer and contract strategies.

The first part of the paper defines the methodology. In the second part he utilizes the calculus to analyze the implications of the model and to derive a variety of graphs and charts. In the conclusions he discusses the implications of the model.

12. A Method for Selecting Contract Cost Incentives. Ralph E. Miller, March 1967, 73 pages.

Mr. Miller proposed a research methodology that the government could use for evaluating the relationships among shares, target costs and target fee. The essence of the model is that first the contractor is requested to respond to two or more pre-determined shares (15 and 30 used); then the government selects the desired mix. From this data industry behavior could be developed in the form of averages.

The study has four parts: 1) The introduction, 2) An empirical method for measuring the effects of incentives, 3) A proposal for extending the scope of contract negotiations, and 4) Preferred sharing arrangements.

The specific requirements of the process are summarized as:

1. The government must define at the beginning the share arrangement, the target costs and the target profit for determination by negotiation.

2. The government and the contractors must reach agreement on sets of mixes associated with each share and
3. The contractor must be permitted to make offsetting adjustments in the negotiations of target fee and target cost.

The paper concludes with a discussion of the necessary requirements in the proposed methodology to assure its effectiveness.

13. Multiple Incentive Contracting: Scientific Contracting with Accent on Trade-off. Normal H. Smith, May 1967.

Smith emphasizes that a method for the analysis of incentives so that the true relationships between cost and performance and their influence on the fee earned may be known in advance of negotiation.

The report and the accompanying computer programs were based on the "DOD Incentive Contracting Guide" (1965), and the "Trade-off Analysis and the Tabular Model Related To Incentive Contracts" (1965) from USAF Academy, Colorado.

The report has three sections and six appendixes. They are:

1. Scope, objectives, and background
2. The trade-off analysis
3. The tabular model

The basis of the presentation is a sample problem. Various aspects are analyzed such as definition of the problem, setting values to the targets, weighting of each incentive element, determining the range of incentive effectiveness, and the changing of the weighting of the incentives as each element advances and recedes from target. Included are the computer source program and the necessary data base required. The program is applicable to any contract where there is a cost sharing element. The purpose of the program is to

provide the government with as much control as possible over the contractors' trade-off decisions by predetermining their effects.

14. Decision Making Under Aggregate Uncertainty: The Engineering Decisions in a System Development Project. F. S. Timpson, June 1959, 22 pages.

Timpson's research was undertaken to show that engineering and decision making analysis could be combined and that this combination would be a new method for studying decision making under a condition of aggregate uncertainty. The method was specifically constructed to be useful for analyzing multiple incentive contracts.

The engineering aspects of a system development project were discussed and a model for simulating decision making in the engineering environment was described. To demonstrate the method, a hypothetical aircraft development project was established. The results of these simulations were discussed. The usefulness of the method for comparing and analyzing decision making policies and incentive contracts was then demonstrated.

15. Quantification of Contractor Risk. Clifford W. Marshall, Polytechnic Institute, Brooklyn, NY, December 1969, pp. 531-541.

Initially the author stresses the problem of subjectively determined contractor risk. The paper's quantitative approach uses intuitively desired features that are based on contractor's utility functions. The three factors isolated as being associated to risk assumption are: 1) The variation in costs due to real world uncertainties, 2) The contract structure and 3) The contractor's utility. After establishing the relationships mathematically the variables are related to contract types. In terms of fee three components are isolated: 1) The service fee for doing work, 2) The actuarial fee for its

assumption of risk, and 3) The incentive fee paid for deviations from target. The author suggests that much of the difficulty associated with incentives is the failure to distinguish between actuarial and incentive fees. Therefore, the incentive should not be paid for risk assumption. Risk assumption should be paid for by a fixed actuarial fee incorporated in the target profit. Changes in the incentive fee do not indicate changes in the assumption of contractors risk.

16. Maximum Profit Incentives in the 1970's. Schick, George J. and Pace, Dean P., Fall 1970, 8 pages.

Schick and Pace present a model for the development of multiple incentive contracts that would permit achievement of the maximum profit. They maintain that the multiple incentive contracts of the 1960's did not in reality permit the attainment of maximum profit since the variables were independent. In contrast, in their model they make the elements of the incentive interdependent and thus achievable. In the rather short article five cases are presented with accompanying analysis and related tables of results. Other interdependent models such as Gemini and FIIM permitted interdependency but were too complex. The authors attempt to present a simple model that can be used without the aid of calculus or the computer.

17. Optimal Incentive Contracting: A Constrained Game Theory Model. Joseph L. Midler, June 1970, 19 pages.

The author develops a theoretical model for the design of incentive contracts between the government and private contractors. The methodology is based on game theory. Zero-sum games are operation research algorithms for the solution of certain classes of problems. The interest in this article is

the insight it provides into the author's perception of the variables involved in the design and negotiation of incentive contracts. Part One is an introduction, Part Two summarizes the basic concepts of two person zero-sum games, and Part Three describes the economic problem facing the contractor and the government. In Part Four the authors briefly summarize the policy uses of the model.

18. Method for Relating Multiple Performance Parameters to a Single Incentive Uniquely. B. Ostrofsky and E. G. Triner, University of Houston, Winter 1971, pages 25-32.

The authors apply probability distributions for the design of multiple incentives. A method is described for relating a single performance parameter to a value scale and then to multiple incentives. Procedures are presented for relating multiple performance areas to a single incentive scale so that the resulting joint performance leads to one and only one incentive award. A hypothetical example of a manned bomber is used with weight and maintenance man-hours as the incentive variables. The point at which the contractor would maximize profit is rarely the same point that would maximize system effectiveness. The article suggests that this problem can be avoided by the appropriate representation and structural relationships among the variables. The limitations of the method are listed as:

1. There is rarely equal weight among the variables.
2. It is difficult to relate the performance requirements to the prime parameters.
3. It is difficult to define the anticipated performance along each range of the variation of the parameter, and
4. It is difficult to determine the appropriateness of the value scale.

19. Incentive Contract and Competitive Bidding. David P. Baron, Associate Professor, Northwestern University, IL, July 1971, 22 pages.

Baron presents a mathematical analysis of the bidding process in which a firm has an opportunity to bid on an incentive contract. The firm considered has a fixed level of operations and operates in the private sector. The incentive rate is fixed. The paper is divided into: (1) An introduction, (2) The model, (3) Taxes, size effect, uncertain costs and private sector profits, (4) Sensitivity to the contract terms and cost and, (4) Conclusions. The author assumes that the price should reflect five factors from the model: cost, the firm's subjective probability of receiving the contract, the firm's attitude toward risk, the level of the private sector profits and the contract parameters of target profit and profit rate. Relationships among the variables are developed and then calculus is applied to explore optimizations for various relationships. He concludes:

1. The effect of risk aversion on the optimal bid price is essentially to decrease the bid price and thus the most risk averse firms will appear to be the most efficient.
2. If firms have the same cost, utility functions and initial wealth level, the firm with the most risky private sector profits will have the lowest bid price with decreasing absolute risk aversion.
3. Increases in the incentive rate are likely to result in higher bids. This would mean that incentives may not be any better for the buyer than CPFF.

The author also includes a summary of some relevant research:

McCall--considers risk aversion in his studies.

Deavers and McCall--no conclusive relationship between underruns and incentive rate.

I. M. Fisher--underruns are greater for FPP than for most CPFF but suggests this may be due to higher targets. He found no relationship between the terms of the contract and the overruns.

John C. Cross--presented an empirical examination which suggests that incentive contracts may not be as effective as often claimed.

Frederick T. Moore--reported that the shift from CPFF to incentives saved ten cents on the dollar.

20. MICAP--A Visualization of Incentive Contracting Study Report. Davies R. Powers, LTC., USA, November 1973, 25 pages.

Lt. Colonel Powers described MICAP, goes through the graphical and tabular outputs and demonstrates its use and application. He states the objectives of incentives and suggests that MICAP through its ability to test the implication of the design of the incentive assists in assuring that the intent is indeed reflected in the parameters selected and the interrelationships defined in the structures. MICAP is a computerized analytical technique for the design and analysis of multiple incentive contracts. Through a series of iterations the designer can approximate the goals of the contract through the necessary adjustments to the contract structure as suggested by the MICAP analysis.

21. An Objective Functional Approach to Structuring Contractual Performance Incentives. Paul Edward Pirdle, Major, USAF, November 1975, 79 pages.

Major Pirdle developed a technique for designing performance incentives that correlated the sensitivity of LCC to the desired performance parameters. There are five parts to the study: (1) Introduction, (2) Background of incentives, (3) Method and system application example where he demonstrates his

concepts, (4) An illustration from a specific example of a subcontract item and (5) Summary and conclusions. Four appendices are attached. He states that his review of the literature suggests that there is "No evidence that incentivization for either cost or performance has provided significantly improved contract outcomes." Further, "The freedom provided the contractor within the incentive has not provided contractors significantly greater profit."

The approach suggested is to structure performance incentives by direct transformation of the customers cost variations of the performance parameters. The intent is to achieve the desired design characteristics which the contractor is responsible for rather than a projected level of LCC which he might have no control over. The slope or scale of the incentive is directly related to the degree of variation of the LCC as a function of the performance.

22. Incentive Contracting for National Defense: A Problem of Optimal Risk Sharing. J. Michael Cummins, August 1976, 35 pages.

Cummins analyzed risk sharing in defense contracting within an insurance framework. He assumed conditions under this risk sharing between the firm and the government can be expected to occur. He then identified the important exogenous characteristics of the firm that determined the equilibrium set of contract terms. Public policy implications can be derived from a normative comparison between the simple incentive structure currently used in defense contracting and a modified contingent claims arrangement. The author claims the latter to be superior in providing desirable risk sharing, while also maintaining appropriate marginal incentives for cost control.

There are two principal policy implications derived from the model. First, attention should be directed toward discerning the contracting firm's degree of risk aversion and its extent of moral hazard, rather than focusing upon the magnitude of cost overrun and the percentage profit fee on the contract. The article suggests that the latter provides no useful information concerning the efficiency of the incentive contracting mechanism, nor the extent to which actual project cost is being controlled. In contrast, knowing more about the firm's attitude toward risk and its propensity for moral hazard can lead to more efficient contractual arrangements and helps to minimize the level of expected cost to the government consistent with the relative bargaining strengths of the two parties. The second policy implication is based upon the proposed superior efficiency properties of a contingent claims contracting mechanism over the simple incentive contract currently used. The impractical nature of the complete contingent claims contract necessitates a modified version, which combines the practical advantages of the simple incentive contract with the superior efficiency properties of the contingent claims arrangement. The result is a flexible mechanism that specifies broad classes of possible outcomes, and applies a different set of contract terms to each class.

23. More Effective Cost-Incentive Contracts Through Risk Reduction, Defense Mgt. Journal, July 1978, Captain William F. Moore, USAP and John M. Cozzolino, Business Risk Education Center, Wharton School, University of Pennsylvania, July 1978.

The authors argue that the traditional approach to incentives has proved to be ineffective. The problem as they see it is that the level of perceived risk (risk adjusted value) is such that contractors act to minimize risk

rather than maximize profit. The answer is to reduce the risk adjusted value by permitting companies to form consortiums to share the risk and by dividing the large procurements into less risky packages. In the process the authors use several techniques from decision theory: expected value technique, utility functions as an expression of risk acceptance, the lottery to establish a base line for a risk coefficient and probability theory.

The paper is divided into six parts. These with a summary of each are:

(1) Formulating incentive contracts, then quotes Scherer's 1964 cost incentive paper to conclude that contractors are not motivated under incentives to maximize profits. For the 306 contracts studied Scherer found that 65% of them had underruns. If the contractors had tried to maximize profits they would have negotiated fixed price contracts. (2) On averting risk, they point out that incentive contracts do not motivate cost reduction due to: (a) The user cost function which is the need for technology to win future contracts, (b) Taxes of 50% reduce the effective share, and (c) The uncontrollable cost components may dominate. (3) On risk adjusted value, they introduce the risk adjusted value to define the real perceived risk by the contractor. They use expected value, exponential functions, and utility theory. (4) The Indifference point is computed through the lottery technique. The higher the risk adjusted value the less is the decision maker concerned with loss. (5) The authors argue that risk reduction can be accomplished by sharing the risk through some contractor consortium or by breaking the program into parts. Finally in (6) the authors consider the practicality of their suggestions in light of the present environment.

24. A Technique for the Structuring, Analyzing, and Evaluating Multiple Incentive Contracts. Wayne R. Fleming and Frank V. Moore, NASA Langley Research Center, Hampton, VA, June 10, 1966, 19 pages.

Fleming and Moore develop a proposed method for the design of multiple incentives. The basis of the proposed method is the value statement concept. Then they developed the method and tested it with an actual procurement. Their premise is that the government fails to properly convey its requirement to prospective vendors and consistently places them in a position where they cannot respond. To remedy this problem the government must provide the worth of increments of change to the contractor. The value statement is their proposed solution. It is defined as the break-even point for trade-off decisions among the variables. The paper describes and gives examples of such a technique. The parts are: 1) The contents of the proposal--a description of how the proposal must be written, 2) Structuring the incentive--and examination of six actual bids received, and 3) An analysis and evaluation of the six proposals. The method is called PRICE--i.e.:

P...Position (Relative Technical Position)

R...Risk

I...The Motivational Factors

C...Cost (Target and Range)

E...Effectiveness (The Proficiency of Management)

Each of these factors are used to develop and to evaluate the proposed multiple incentives.

25. Effects of Incentive Contracts in Research and Development: A Preliminary Research Report. Edward B. Roberts and J. Barry Short, April 1961, 21 pages.

These MIT scholars studied the effects of incentives through evaluating the impact of shifting CPFF contracts to incentives. Thus, they address what the behavior would have been in the absence of the factor being studied. Five contracts from five million dollars to two-hundred million dollars were reviewed. They also conducted interviews with government and industry personnel. The paper is organized as follows:

1. Contractor Decision Making
2. Length of Negotiation
3. Setting Target Cost
4. Sharing Arrangements
5. Contract Changes
6. Contractor Behavior
7. Management Attention
8. Subcontracts, and
9. Cost Allocation and Control

The "tentative" conclusions indicate that:

- (1) There is a likelihood of prolonged negotiations and delays,
- (2) There possibly are harmful effects through the potential loss anticipated by contractors. This is somewhat counteracted by the possible desirable contractor behavior resulting from prospects of attainable increased profits,
- (3) There is increased attention for control of changes by the government and the contractor,
- (4) There is an increased relative payoff for skilled negotiation rather than technical performance,
- (5) There is an increased management involvement, and,

- (6) There are added difficulties especially with multiple incentives of maintaining consistent and appropriate motivations throughout the contract life cycle.

Generally the authors suggest that the research casts grave doubts of the effectiveness of incentive contracting for R&D. Also, contractors are highly motivated by possible losses on incentive contracts and this may result in harmful shortcutting. All the major subcontracts were converted by the prime from CPFF to FPI or CPIF. Contractors avoided the risk of financial penalty when converting by (1) stalling to let time reduce the uncertainty and (2) refusing to negotiate agreements that had high shares.

26. An Analysis of Military Procurement Policies. John J. McCall, November 1964, 54 pages.

McCall, judging that statistical analysis of incentives have not adequately modeled their behavior, proposed an economic model for the evaluation of incentives. After developing the model he tests it with AF data on contracts from the Aeronautical Systems Division, Wright-Patterson AFB, Dayton, Ohio. In his opinion his own model more adequately predicts contractor behavior.

The paper is presented in four parts: (1) an introduction where the results of empirical statistical models are discussed, (2) An economic model of procurement where the FP, FPI, CPIF and the two bid contract are explored, (3) The restructuring of the procurement model, where the initial and adjusted costs, the influence of contract size, and the estimation of the actual asymmetrical sharing proportions are explored, and (4) Conclusions.

Some conclusions were:

1. Efficient firms (low cost) are driven to submit higher than actual target costs.
2. Inefficient firms tend to submit bids lower than anticipated contract costs.
3. Bids are unambiguous indications of cost only with FP contracts.
4. The economic model proposed predicts the above; prior statistical analysis do not.
5. Other factors such as quality of product and schedule are also important and have not been investigated.

27. McKean, AF CONTRACT NO. F33615-80-C-5103.

McKean analyzes the current procurement methodology "through the critical logical outcomes of the assumptions that form the basis for the contractual incentives and their negotiation." His analysis is divided into four parts: (1) Economic performance in the defense industry, (2) Cost plus fixed fee contracts, (3) Incentive fee contracts, (4) A possible alternative approach.

In section one he concludes that the efficiency and stability of performance leaves something to be desired. The sales variability and the employment variability for the principal firms in the aerospace industry were higher than for the comparative four industries studied. Under the CPFF section he points out that it is not just uncertainty, but uncertainty combined with large size that makes the aerospace industry risks so high. Since large firms are risk averse the answer is the CPFF contract. He argues that both the government and the contractor accept high risk uncertainty because it is to their advantage. The major reason is that under uncertainty a wide range of behavior can be defended. In this fashion contractors can make investment type expenditures to enhance further reputation and the government

can make overruns defensible to the Congress. The other effect of the CPFF is to relax on-the-job administrative burdens that relate to efficiency. Contractors under CPFF expand their staff and in-house capabilities. In short, uncertainty frees the contractor and the government from critical efficiency reviews. This is particularly important to the government because large problems tend to be more uncertain. And the Services are engaged primarily in the defense of the United States, and not in saving the taxpayer's money.

Under part three of the paper McKean attacks the reported 10% savings from the shift of CPFF to incentives. In fact he argues that with the CPFF the joint interest of the parties bias the target cost downward. Whereas with the incentive the bias is up. He analyzes bargaining behavior and the sharing rate and investment expenses through the differentiation of total cost and profit functions and concludes that least cost contractual objectives are the appropriate goals for the government. The increase in the share rate which is designed to discourage expenditures may be offset by capital expenditures to invest in the future. He finds "that the behavioral assumptions required to establish, a priori, the direction of the effect of profit incentives on cost performance are quite implausible, and a very sophisticated statistical analysis would be necessary to determine the effect." In part four he suggests that the key is to reduce uncertainty. The way to reduce uncertainty is to break the "system buy" into meaningful parts and to contract for them separately.

28. Defense Contracts: An Analysis of Adaptive Response. Oliver E.

Williamson, RAND Corp., June 1965, 70 pages.

This study evaluates the use of incentive contracts as they relate to the cost of development efforts. The author concludes that incentives are

ineffective due primarily to alternative adaptive responses available to the contractor. He recommends that the development effort be partitioned thereby reducing uncertainty, risk and overruns (this is similar to McKean's point).

The inquiry is deductive in nature. It uses secondary data. There are five sections. (1 and 2) presents an outline of the problem, (3) examines adoptive responses to CPFF and CPIF contracts respectively, (4) presents a partitioning theory and (5) outlines the conclusions.

He argues that the opportunities for adaptive response renders both the direct control through contractor financial and technical operations and indirect control through incentives ineffective. He adds several points:

1. The author is skeptical about the claims that incentives result in cost efficiencies.
2. The author states that the proposition that negotiated costs are not related to share rates is difficult to sustain.

X. Indifference Theory Applied to the Incentive Contracts

There are only a few papers in the literature on indifference theory and incentives. And in fact all of them are from Texas A & M students and/or faculty. The concept is quite straight forward. Indifference curves are similar to isoquant curves from economics or isofee curves used in PIIM. In these papers the concept is applied to the design of incentives. The general thrust is its application to system maintainability and reliability. One of the papers expands the use of life cycle costing. All these papers could easily have been grouped with the other papers utilizing mathematically based approaches for the analysis and design of incentives. These have been isolated as an example of a particular technique applied to the incentive contract.

1. The Application of Availability to Linear Indifference Contracting. G.

Thomas, April 1971.

In this paper methods are developed for applying both maintainability and reliability considerations to an incentive contracting plan that utilizes the concept of indifference. The resulting contracting scheme is applicable to situations where systems costs exhibit a linear relationship to system availability. The plan is such that the contractor is paid according to the availability demonstrated by the equipment during actual field use. Statistical techniques based on both consumer's risk and producer's risk are used in determining the required number of renewals. A procedure for establishing confidence limits on the purchase price is also derived. Discussion of some of the factors involved in determining the linear indifference function are also provided.

This is one of several articles in the literature that applies the concept of indifference curves to resolving the problem of decision making under conditions of uncertainty.

2. Incentive Contracting Based on Reliability and Consumer Indifference.

Byron W. Butler, Joseph W. Foster, July 1971, 77 pages.

Two different incentive plans which utilize the concept of life-cycle costing and systems worth are developed. One plan is based on the assumption of an exponential failure rate and uses this as a basis for determining systems worth. The other plan assumes no underlying failure rate distribution and uses non-parametric testing procedures for determining product reliability. Both plans use the concept of consumer indifference by adjusting the purchase price according to the product reliability as determined by field test.

3. Linear Indifference Contracting for Maintainability and Reliability.

Richard L. Reynolds, 1971.

An incentive contracting plan for reliability and maintainability based on the life cycle support cost of the item is the focus of this paper. The contract is awarded to the system with the lowest life cycle support cost. The purchase price is determined by the field performance of the equipment.

The advantages are (1) The elimination of inefficient maintainability and reliability demonstrations. (2) The customer receives within certain confidence bounds the reliability and maintainability for which he pays. (3) The producer is supplied with an incentive to produce at a high level. (4) The customer is forced to keep accurate records of the system. (5) The parameters obtained will be the most accurate since they are obtained in an actual use

environment. And the disadvantages are: (1) It cannot be applied to research contracts. (2) It requires the contractor to be very large in order to stay in business while waiting for the purchase price to be determined. (3) It may be very difficult for the customer to determine how he is indifferent. And (4) it is limited to the case of linear indifference and exponential distributions.

4. Consumer Indifference Curves. Roger L. Spangenberg, March 1973, 87 pages.

The author applies indifference curves to the design of incentives.

There are five parts to the paper: (1) The introduction where he reviews the current forms of incentives, indifference theory and practice, and life cycle costing, (2) Indifference contracting background and proposed plan, (3) The development of indifference curves through life cycle costing, (4) Generating indifference curves using a queuing theory approach, (5) Examples of the queuing model and (6) Summary and conclusions.

In the conclusion two plans are suggested for the purchase of reliability, one in which the customer asks for bids on purchase price for a specified value of reliability, and two where the customer asks for bids on the total ownership basis. He concludes that indifference curve contracting "is still a bit sketchy."

XI. Applications of Incentives Contracts Use and Abuse

Incentives have increasingly been applied to a wider and wider scope of procurement situations and end items. The purpose of this series of papers is to illustrate their varied use and to highlight areas of abuse. Included are such applications as: 1. Component standardization on shipboard, 2. Increased asset availability, 3. Reliability improvement warranties, 4. B-58 Aircraft components, 5. Subcontracts, and 6. Radar.

Another aspect of this section is potential abuse. Several cases are cited as documented by the GAO and the Controller General. Cases such as these can provide a rich source for the study of incentive contract effectiveness.

1. Overstatement of Target Cost of AN EPS-7 Radar Equipment Under Fixed-Price Incentive Contracts of 30(635)-12300 and AF 30(635)-11072 with The Comptroller General of the United States General Electric Co. Heavy Military Electronics Department, November 1964.

Since the time period discussed in this report, substantially more emphasis has been placed on the use of cost and pricing data in negotiating contract prices. This emphasis has been manifested in regulations and directives issued by the Department of Defense and the military departments and congressional action. The author notes that Public law 87-653, effective December 1962, now required with certain exceptions that contractors submit cost or pricing data and certify that the data submitted is accurate, complete and current.

Under incentive-type controls, the reasonableness of the cost estimates included in the negotiated target cost has an important bearing upon total costs to be incurred by the government. An overstatement of the target cost

not only increases the target profit without any sound justification but also permits the contractor to receive as additional incentive profit a share of cost underruns which results from inequitable cost-estimating practices rather than from efficiency or economy in contract performance. The primary purpose underlying the use of incentive contracts--to reduce costs to the government and at the same time to reward the contractor for efficiency and economy in performance--cannot be fully achieved unless realistic target costs are established on the basis of accurate, complete and current cost and pricing information.

The target costs negotiated for contracts--11072 and 12300 were grossly overstated. The reasons cited were : (1) costs were not based on current cost or pricing data already available, (2) costs were not based on the appropriate costs which could have been obtained through prompt action prior to negotiations, and (3) were not properly related to the revised requirements of the contract.

2. Over-pricing of B-58 Aircraft Components Under Cost-Plus-Incentive-Fee-Purchase. Comptroller of the U.S., April 1964.

This Comptroller's study reviewed the prices proposed for thirty-one of the purchased parts which Sperry included in the target costs for primary navigation systems and evaluated the reviews of the purchase orders made by Convair and the Air Force. It also considered cost data and other information pertinent at the time target costs were available.

Overruns, intentional and otherwise are often associated in the minds of the general public with the government procurement of weapon systems. Scherer and Peck in their Weapons Acquisition book highlighted the alleged abuses. This particular study of the overpricing of the B-58 component parts provides

the interested reader with a good grasp of the nature of the overruns and how they are initiated in the accounting process. Public Law 87-653, effective December of 1962, required contractors to submit cost of pricing data that is certified as accurate, complete and current. This report is an example where the examining government body concluded that the law was not adhered to. In the inquiry on the effectiveness of incentives and the accuracy of the negotiated targets it sheds some interesting light on the process of alleged deception.

3. Incentive for Achieving Component Standardization in Ship Construction.

Logistic Management Institute, December 1967.

The purposes of the study were:

1. To appraise the effectiveness of the present incentive clauses toward achievement of improved standardization of ship equipment,
2. To develop, if feasible, uniform criteria for establishing the amount of monetary incentive required to motivate ship builders to standardize on ship components in the overall best interest of the government, and
3. To develop recommendations for useful modifications to the presently used incentive clauses which will provide improved overall benefits.

The conclusions reached were:

1. The equipment standardization incentive clauses examined are not likely to result in a significant increase in the degree of standardization achieved in each respective contract over the degree which probably would have been achieved without the incentive.
2. The equipment standardization incentive clauses have made a significant contribution in attracting management interest in dealing more effectively with the problems of standardization, and the interest should be nurtured

by developing incentives which more realistically relate contractor achievement to Navy benefits.

3. Except for intro-contract standardization, the contractor incentive approach to achieve equipment standardization is a more feasible and effective approach than applying mandatory requirements.

4. The present equipment standardization incentive clauses require modification in at least three areas. They need (a) a wider scope of interest including intro-ship standardization and preferred component selections; (b) an incentive base that relates to the total degree of standardization achieved rather than to the smaller degree achieved of several selected categories; and (c) an incentive rate more directly related to Navy benefits.

5. An average supply cost per line item at the shipboard level by appropriate ship classification or by total fleet should be established for the purpose of making standardization or other economic analyses.

6. An equipment commonality ratio normally achieved without standardization incentives should be established for various types of ships under several conditions, and subsequently used as a base from which contractor standardization incentives may apply.

4. Project Management: An Incentive Contracting Decision Model. W. A. Mainhart, Leon M. Delionback, Oklahoma State University, December 1963.

Mainhart and Delionback examined the role of the contractor's project management in a complex research and development program. It concentrated on the question of choice under an incentive contract situation and it sought to provide an understanding of the problems and pressures facing the contractor.

Although the model was developed to enhance understanding and not as an operational technique, it suggests that it may be possible to develop a

working model that would be directly useful to the project manager. It would offer to the project manager strategy guides and a mental set useful in incentive contrast decision problems. As with all models it would require empirical verification in order to establish the future potential usefulness.

An alternative approach would be to make an adoption of the model so that it could be used by a government agency. Since profit motivation would be absent, some other utility function would have to be substituted. The management scientist can learn much from research on the project management form of organization.

5. The Air Surface Missile System Incentive. John J. Kennedy, March 12, 1969, 75 pages.

This study analyzes the Navy RFB on the ASMS for RCA. It is divided into several parts: (1) Introduction which reviews government policy, (2) The factors affecting the design of the incentive (present value versus future rewards, linear rewards and penalty rates, ranges of incentive effectiveness, and changes). (3) Structuring the ASMS multiple incentive (derivation and use of the cost effectiveness studies, application of discounting rewards and penalties), (4) the ASMS contract (cost, schedule, operational availability--18 elements) and (5) Management of the incentive (decision making, GPZ, sub-contractors and contract changes). There are five appendices--Cost studies analysis, approaches considered for the operational incentive, cost effectiveness decisions with the ASMS, contract changes, and the statistical basis for operational validity tests. In addition there are 9 tables such as missile life cycle costs versus reliability and expected incentive and the probability of failure as a function of true availability, and five figures such as FPI incentive parameters and matrix of incentive information.

The document is an example of the level of sophistication that the major firms apply in preparation for the negotiation of these major system contracts. It is also a valuable source for the novice to understand the implications of a government RFB in terms of government goals.

6. Analysis of the ASMS Request for Bid for RCA, Moorestown. Professor John J. Kennedy, Department Chairman, Marketing, University of Notre Dame, Notre Dame, IN. March 1969, 83 pages.

The air surface missile system was procured through a rather complex multiple incentive which was defined in the Navy's request for bid. This document is the analysis of the request for bid. It presents an analytical evaluation of the RFB and develops options for purposes of negotiation. It includes ten parts: 1) Introduction, 2) The factors affecting the design of the ASMS incentive, 3) Structuring the ASMS multiple incentive, 4) The ASMS Contract, 5) The cost incentive, 6) The schedule incentive, 7) The operational availability incentive, 8) The test plan, 9) Missile reliability, and 10) Management of the incentive.

The paper is an example of the nature and kind of analysis that goes into the preparation for negotiation for the design of an incentive contract. The analysis includes graphs and charts and involves topics such as the cost effectiveness of incentive decisions, the application of the value system to potential trade-offs, and overlap. It is a good example of the analysis a defense contractor goes through in his preparations for negotiations.

7. Escalation Provisions in DOD Procurement: A Review of the Problem and a Framework for Analysis. Lt. Robert W. Eberth, USN, December 1974, 40 pages.

Lt. Eberth reviewed the opinions and concerns expressed by various government and private industry sources with regard to the use and structure of escalation (i.e., economic price adjustment) provisions in government procurement contracting. There was found to be little general agreement among these sources on many of the aspects of escalation provisions, including the 'proper' objectives of such clauses. After this review a framework was designed to facilitate the analysis of the relationship of escalation provisions and price level uncertainty. The specific model employed examined interacting objectives of the government and a firm in a sole-source contract negotiation scenario. A method was developed to approximate the increase in contract price required by the firm as compensation for accepting the risk of uncertain price levels. A criterion was established for the employment of the escalation provision in the modeled scenario.

The incremental target cost approximation was noted to be valid only near the solution, but was considered sufficient for the purpose. This resulted from using the approximation only to define a 'break-even' relationship between the dollar increase in price, due to inflation, and the cost of administering an EPA clause, which was implicitly assumed 'small' compared to the total contract cost. The analysis led to the conclusion that, under the assumptions made, the EPA clause should be applied when the 'inflation contingency', as evaluated by the approximation developed, exceeds the administrative cost of that clause.

The formulation of the model did not permit a direct analysis of the concurrent problem regarding the effect of using the EPA clause, as structured, on incentives to maintain control over inflationary trends within the firm. The analysis did not, however, disclose any effect of the EPA clause (or lack of it) on the cost-reduction incentives as represented by the incentive profit

rate, leading to the conclusion that, if cost-reduction incentives were effective without the EPA clause, they would be no less effective with the clause.

8. Need for Increased Use of Value Engineering. A Proven Cost Saving Technique in Federal Construction. Multi-agency, U.S. General Accounting Office, May 1974, 52 pages.

As stated rising costs of labor, materials, and money have given management a sense of urgency in developing techniques that promote economical construction. Value engineering is one technique that has effected cost-savings on federal construction projects. GAO examined value engineering activities at 10 federal construction agencies to evaluate their use of value engineering incentive programs and circulation of proven value engineering proposals within and among the agencies. The GAO concluded that (1) Proven value engineering proposals should be circulated both within and among federal construction agencies. Such circulation will bring the latest cost-saving ideas, techniques, and materials to the attention of those responsible for designing, approving, and constructing projects. (2) The potential benefits of circulation will be maximized by the designation of a central point at which proven proposals can be screened to identify those having further application. The central point should categorize the proposals by engineering discipline and circulate them regularly. The recommendations were that the General Services Administration establish a system for: (1) Receiving from federal construction agencies all approved value engineering proposals, (2) Screening the proposals to identify those having potential for further application, (3) Categorizing such proposals by engineering discipline, and (4) Circulating such proposals regularly to federal construction agencies.

9. Potential Adverse Effects of Competitive Prototype Validation. Lt. Col.

James A. Evans, USA, November 1974, 31 pages.

During a visit to the Defense Systems Management School in September 1974, General Henry Miley, Commander, Army Material Command, expressed concern that competitive prototype development under cost-plus incentive fee contracts might also include increased potential for cost growth and goldplating. The thesis was that the prime motivator for the contractors was to win the follow-on contract. This dominant motivator then rendered the cost incentive fee ineffective since the contractor would spend whatever he feels was necessary to win. The competitive aspect of this situation might also lead the contractors to add a little goldplating to their product if they perceived it would give them an edge over their competition at source selection for the follow-on contract.

It was concluded that General Miley had identified a potentially very costly disadvantage to competitive prototype development. This was not to say that this type of development was not useful. The author felt that on the contrary, being aware of the pitfalls would enable the government to practice the concept of competitive prototype development to its greater advantage. This study showed that there was no one best type of contract for use in all competitive prototype development programs. The best contract is one which has been tailored to the specific situation. A set of questions was included which was to serve in selecting the best contract type for a specific competitive prototype program. The ability to answer these questions accurately and hence select a best contract type would be heavily dependent on detailed knowledge of the contractor and his objectives.

10. Control of Production Unit Cost in Major Weapons Systems Acquisitions.

Lt. Col. Peter B. Xanyon, USA, February 1974, 57 pages.

The purpose of this paper was to examine the ways and means by which the Department of Defense and its senior military and civilian program managers can achieve and maintain control of the production unit cost of major weapons systems. Over the last several years, with an acquisition background replete with cost overruns, the DOD, the services, and industry have struggled with ways and means to estimate and establish control over the development costs of major systems acquisitions. At present a number of techniques are being incorporated into development contracts in order to maintain control of research and development expenditures. These are outlined and discussed.

11. VE and Design to Cost. R. E. Biedenbender, March 1974, 17 pages.

This paper was presented at the design-to-a-cost seminar of the American Institute of Industrial Engineers/Aerospace Division, Washington, D.C., 27-29 March, 1974. Its purpose was to address the interfaces between value engineering and design to cost. There was obviously considerable difference of opinion about this interface. This is not surprising when one considers that both subjects are controversial in themselves. To illustrate this situation, the paper lists some of the more frequently heard 'platitudes' about VE, Design to Cost, and their relationship. All of these platitudes obviously cannot be right. Yet they are all honest opinions held by reasonable people. These differences are based upon the different perceptions of VE and Design to Cost. These perceptions are frequently derived from the individual's observations of practice, as opposed to theory and concepts. This discussion can shed light on the use of VE and Design to Cost with incentive contracts.

12. The Condor Missile System Claim: An Analysis with Implications and Recommendations for Project Managers. William Rutherford Pierce, Lieutenant, USN, March 1974.

The purpose of this paper was to provide recommendations for the improvement of current procurement policies and procedures in the Department of Defense. The study addressed the following objectives:

- (a) To evaluate the appropriateness of various types of contracts for the development of major weapons systems.
- (b) To determine an improved policy for unofficial communications between government and contractor personnel in order to avoid claims resulting from unauthorized changes to the contract.
- (c) To investigate the impact of large claims on the congressional acceptability of major programs.
- (d) To determine the legal implications of dual authorship of specifications when these specifications are impossible to attain in contract performance.

The use of the FPI for a situation similar to the Condor Program in 1966 would, in 1974, be inconsistent with the ASPR. This suggests that cost type contracts should be used in engineering development contracts. A fixed price contract should be avoided in all but a few cases. This study is of interest because it illustrates the relationship between performance and contract type. It implies that the risk in FP contracts is too great for areas of high technical uncertainty. Other authors (Fisher, Jones, etc.) have suggested that no relationship exists between these two parameters.

13. Escalation Provisions in DOD Procurement: A Review of the Problem and a Framework for Analysis. Lt. Robert W. Eberth, USN, December 1974, 40 pages.

Eberth builds a model to evaluate the impact of escalation provisions and looks at its use in incentive contracts. He felt that the areas of controversy with regard to escalation provisions appeared both too wide and too inter-related to be able to concentrate on any one without first obtaining a more thorough understanding of how escalation provisions affect a firm's attitude toward inflation or uncertain price levels, and how this attitude is reflected in its pricing of a contract. To this end, it was felt necessary to "start fresh," to develop an analytical framework which would both permit such an understanding of the theoretic nature of escalation provisions and provide the basis for further, more detailed investigation of the effects of employing differing types of escalation provisions.

The results of the negotiations model analysis were:

1. The incremental target cost approximation.

The incremental target cost approximation was noted to be valid only in a small neighborhood about the solution but was considered sufficient for the purpose. This was due to using the approximation only to define a "break even" relationship between the dollar increase in price, due to inflation and the cost of administering an EPA clause, which was implicitly assumed "small" coupled to the total contract cost.

2. Application of the EPA Clause.

The analysis led to the conclusion that under the assumption made, the EPA clause should be applied when the "inflation contingency," as evaluated by the approximation developed, exceeds the administrative cost of that clause.

3. Effect of Inflation and Cost-Reduction Incentives.

The formulation of the model did not permit a direct analysis of the current problem regarding the effect of using the EPA clause, as structured as an incentive to maintain control over inflationary trends within the firm.

The analysis did not, however, disclose any effect of the EPA clause on the cost-reduction incentives as represented by the incentive profit rate. This leads to the conclusion that, if cost-reduction incentives were effective without the EPA clause, they would be no less effective with the clause.

This paper provides additional insights to the questions concerning the estimation of costs, the structure of price arrangements on incentive contracts, and other factors that have an impact on final contract outcomes.

14. Case Studies on a Major Weapons System Acquisition Project. Lt. Michael H. Guth, USN, September, 1974, 53 pages.

These series of case studies were developed to highlight the changing environment of the U.S. shipbuilding industry and to examine the cost and fee differentials between two private shipyards for the overhaul of nuclear submarines. These are used to introduce students to information available within the Navy, and to stimulate classroom discussion of naval policies and practices.

15. Patrol Hydrofoil Guided Missile Ship. Department of the Navy. February 1975, 43 pages.

The patrol hydrofoil guided missile ship (PHM) then in its lead ship construction phase, was to be a new class of small ships to operate offensively against major surface combatants and other surface craft. The PHM was to be 132 feet long, displaces 235 metric tons, and will sustain high speed in full-borne operations in high sea states. The Boeing Company was the lead ship construction contractor. This report summarizes the GAD's conclusions on the success of the procurement. These were: (1) The quality of welding on the PHM ships, especially on the first PHM lead ship, has been inferior. The

major types of weld deficiencies in PHM-1 were incomplete penetration, cracks, porosity, and incomplete fusion. Also, distortion has been prevalent. (2) According to Boeing, weld quality has improved from the start of PHM-1 to the present and the current weld quality was comparable to the best in the shipbuilding industry. The Navy and Air Force believe Boeing has taken many of the steps necessary to resolve the physical welding quality problems, and agree that significant improvements were demonstrated on the PHM-2.

The report concluded that to assure that adequate welding quality will be achieved on any future PHM's, the Secretary of the Navy should require that all in-process controls, which were omitted in the lead ship contract, be specifically cited in any contract award for follow-on ship.

16. Impact of Changes in the Defense System Acquisition Cycle on Design Team Capability Retention. Dr. W. Lee Boddie, May 1975, 53 pages.

Boddie in this study was "to evaluate the effect of changes in the defense system acquisition environment on design team capability retention in the aircraft industry in a manner that would suggest solutions as well as identify the problems." A design team was considered to be the complete engineering team that is required to take an aircraft weapon system from the conceptual phase through development to production and deployment. The changes in the defense system acquisition environment considered are those that have occurred since 1968. The study was conducted using published material, from both government and industry, that addressed the general subject of interest. Since relatively little of this material addressed the specific topic of interest, the author drew heavily from his own knowledge/experience to relate perceived impacts on design teams to the major changes in systems acquisition.

The conclusions were: (1) In essentially eliminating concurrency through the fly-before-buy approach, the already long development cycle has been further lengthened, with all of the implications for design team technological obsolescence, (2) The advanced prototype approach advocated by Mr. Packard appears to have already passed into a period of disuse, (3) The advanced technology development element of the technology base which is now receiving increased attention appears to be an attempt by the service laboratories to meet the intent of advanced prototyping.

The recommendations were: (1) The government commitment should include the legislative as well as executive branches, (2) The basic fly-before-buy approach should be implemented carefully to minimize the adverse effects attendant upon program gaps/stretchouts, (3) Once a design team's product has been selected for further development and/or production, a planned product improvement program should be implemented and continued as long as the results are cost-effective.

17. DCAS/ARTADS Interface on a Contract: An Explanation and Evaluation.

Maj. Russell K. Cleveland, USA, May 1975, 38 pages.

Cleveland investigated the interface between a project manager and the defense contract administration services (DCAS). He did so by studying on a single, on-going contract the interaction between the project manager's personnel, functional support personnel from other Army elements, DCAS support personnel, and the contractor's project team. A primary motivator in the selection of the contract to be studied was the prospective assignment of the author to the Office of the Program Manager, Army Tactical Data Systems (ARTADS). He concluded that ARTADS and the United States Army Electronics Command were not using DCAS fully.

18. Investigation of Reliability-Growth Incentives and Analysis of IDT & E Test Data for AFSATCOM. H. Dagen, G. Harrison, J. Heate, December 31, 1975, 82 pages.

The applicability of the creative use of incentive provisions to reliability requirements in contracts is discussed. The authors reviewed the evolution of reliability growth incentives, recounted their experiences and insights gained from sight visitations, and concluded with a summary of lessons learned. These were: (1) RIW and incentives are applicable to sole source procurements. (2) Incentive options and requirements have to begin at the same time as the full scale development contracts so that contractors can design their equipment to meet the incentive requirements. (3) Careful attention must be paid to incentive implementation problems before the release of the RFP. (4) Misunderstanding about the goals and implementation of an incentive quite often lead to confusion about the incentive itself, and (5) It is difficult to substitute DT & E data for reliability test data.

19. Utilization of Performance Incentives in Production Contracting. James Robert Knepshield, GS-12, DNC, November 1976, 20 pages.

The author addresses the query "Should the production contract contain incentives to improve product performance?" The study addresses (1) incentive contracting, (2) performance incentives in production contracting, (3) product assurance motivators and conclusions. Although he presents evidence from prior research to suggest incentives on production contracts should be on cost only, he still recommends specific performance incentives on quality and/or reliability. These could take the form of traditional incentives, the award fee, or the RIW concept. He justifies his position on the basis of the increasing costs and complexity of weapon systems.

20. Price Proposed and Negotiated for Fixed-Price Incentive Contract

P33657-74-C-0041. U.S. General Accounting Office, November 1977.

This is a report of an examination into the price proposed and negotiated for a fixed-price incentive contract (P33657-74-C-0041) awarded to Northrop Corporation, Aircraft Division, Hawthorne, California, by the Air Force, Aeronautical Systems Division (ASD). The contract provided for the full scale development of two aircraft and was awarded on October 5, 1973, at a target price of \$45,950,000. The examination was made to determine the reasonableness of the contract price in relation to the contractor's supporting cost or pricing data, and whether the requirements of public law 87-653 were effectively implemented. The examination was part of a nationwide review of the pricing of Department of Defense (DOD) negotiated noncompetitive prime contracts.

The review disclosed that the target price was overstated by about three million dollars. This was applicable to add-on pricing factors and profit and was principally because the contractor did not disclose current, complete, and accurate cost or pricing data prior to negotiations. The recommendations were: (1) The Assistant Secretary of Defense determines whether the government is entitled to a price adjustment under the contract and (2) The Air Force determines the impact of the non-disclosure of business data forecasts on negotiated forward pricing rate agreements and the ultimate effect on the pricing of government contracts awarded to the contractor.

21. Reliability Improvement Warranties: An Analysis of Contractor Incentives and Risks. Major Raymond P. Hudkins, USAF, May 1978.

The objective was to analyze defense contractors' perceptions of reliability improvement, warranty incentives and risks. The author sent a thirty question survey to six companies that had reliability improvement warranty experience. The author then integrated the survey results with follow-up telephone interviews and an analysis of other warranty studies. He concluded that contractors see little incentive to improve equipment reliability after two years into a five year warranty. One of several study recommendations was to implement reliability improvement warranties early in development programs in order to influence equipment design and lower contractor risks.

22. Report on the Survey of Policies and Procedures for Paying Progress Payments for New Ship Construction. Financial and Manpower Audits Division, July 1979, 9 pages.

In this report the Defense Audit Service reviewed the policies and procedures for paying progress payments under the Navy ship construction program and evaluated (1) The separate administration of shipbuilding progress payments by the Navy, (2) The policies and procedures employed by the Navy to guard against unauthorized progress payments, (3) The percentage of completion basis for paying progress payments, and (4) The Navy policy and procedures for liquidating progress payments.

Navy policies and procedures for progress payments allowed contractors meeting certain conditions to have a negative investment in contract performance as a benefit of progress payments. Further, these policies and procedures did not provide for uniform treatment of contractors in determining percentages of completion for progress payment purposes. It was concluded that a uniform contract financing policy was desirable. Also, the ability of the Deputy Under-Secretary of Defense, Research and Engineering to monitor

shipbuilding progress payments could be further improved through access to Navy shipbuilding status information.

In cases where the contracts provide for additional incentive as well as escalation payments, such as escalation payment for standard equipment, it was concluded that the contracts must specify whether these payments are included in contract payment limitations.

The use of the earned value data available from the contractors' management systems as a basis for the computation of progress payments could provide more equal treatment to contractors.

Progress payments as they relate to cash flow return on investment and profits generally are a critical area for evaluating final outcomes of contracts generally. The article provides a particular earmark of how the policies and their applications vary.

23. Increased Asset Availability Through Incentives. A. J. Holzmilller, Navy Ship Control Center, Mechanicsburg, PA, May 1979.

This is a very short paper that describes how the Navy applied an incentive contract to improve the management of repairable items. The particular items were the expensive, high demand, critical shipboard repairable components.

The article is divided into several parts: 1) The background, 2) Definition of problems, 3) Selection of candidates for incentives, 4) Contractor discussions, 5) Negotiations, and 6) Anticipated benefits. The article lists nine benefits that they anticipate as outcomes of the applied incentive (examples . . . reduced average turn around time from seven to two months, increase the overhaul yield to 100%, maximize the availability of ready for issue assets.)

24. Subcontract Management: Program Office Involvement on

Cost-Plus-Incentive Fee Prime Contracts. Maj. Larry C. Jackson, USAF, 57 pages.

This study focuses on the management of subcontractors through program office personnel involvement. Generally the government is constrained from management of subcontractors directly by the doctrine of privity of contract. As a fundamental legal principle, this doctrine does not prohibit program office personnel from assuring that prime contractors effectively manage subcontractors. The study lists some current attempts which are underway in an attempt to improve the subcontract management process. The author suggests that: (1) Recent armed services procurement regulation (ASPR) revisions on subcontract management are noteworthy attempts to improve involvement in subcontract management. (2) The implementation of any of the four recommendations contained in the report will result in improved subcontract management.

He recommends: (1) There should be formal subcontract management training; (2) There should be better prime contractor surveillance; (3) A publication of a DOD subcontract management directive; and (4) The ASPR should be revised.

A

APPENDIX

BIBLIOGRAPHY

APPENDIX A

BIBLIOGRAPHY

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